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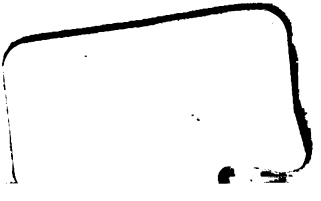

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MINERALS

OF

NEW SOUTH WALES.

ARCHIBALD LIVERSIDGE,

PROFESSOR OF MINERALOGY IN THE UNIVERSITY OF SYDNEY. ASSOC. ROY. SCH. MINES, LONDON. LATE SCHOLAR OF CHRIST'S COLLEGE, CAMBRIDGE.

SYDNEY: THOMAS RICHARDS, GOVERNMENT PRINTER, PHILLIP-STREET.

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THE MINERALS OF NEW SOUTH WALES.

By Archibald Liversidge, late Scholar of Christ's College, Cambridge, Professor of Mineralogy in the University of Sydney.

[*Read before the Royal Society of N.S.W.*, 9 *December*, 1874.]

The title merely of the following paper was read before the Society on the above date, as the paper is not of a nature suitable for reading in its entirety, but is more suited for reference merely.

The descriptions of the minerals are given almost entirely from specimens which I have either collected myself or which have come under my own personal observation; and the analyses have in all cases been made by myself, except where otherwise stated. It is much to be deplored that no systematic examination of the minerals and rocks of New South Wales has been undertaken similar to that performed in other Colonies. The amount of exact information which has yet been published is surprisingly small.

Some of the localities have been taken from papers published by the Rev. W. B. Clarke, M.A., F.G.S., the late Mr. Stutchbury, who was for some time government geologist, and from some of the reports of the earlier explorers.

Great difficulty was at times found in identifying certain of the localities, from the changes which the names of places have in many cases undergone—numbers of localities I have had to reject altogether on this account, and some uncertain ones probably still remain; but as it is my intention on the first opportunity to bring this little introductory paper out in a more complete form, with, if possible, descriptive figures of the more remarkable specimens, I hope to be able to correct any mistakes which may have crept in, and in a paper of this kind it is almost impossible that some should not occur, although I have done my best to keep the number down to as few as possible.

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PART I.

METALLIC MINERALS.

Gold.

Only one true mineral species of gold has up to the present been found in New South Wales, and that is :—

Native Gold.

Cubical system. Well developed crystals are very rare and are never of large size, seldom exceeding $\frac{1}{4}$-inch in diameter, and the faces are usually more or less cavernous; the most common form are the octohedron and rhombic dodekahedron; single and detached crystals are seldom found, they are usually attached end to end, forming strings, wires, and branching or aborescent forms. A beautiful branching tree like group of large rhombic dodekahedral crystals weighing some 20 oz. was formerly to be seen in the Australian Museum collection, but the specimen has been stolen, so that it is unfortunately lost to science. Occasionally elongated crystals of rhombic dodekahedra are met with, arranged in columnar groups very similar to groups of basaltic columns. As with other minerals, the smaller crystals are usually the most perfect. Filiform, reticulated, and spongy shapes are common; but more so are irregular plates, scales, and strings, which interpenetrate the matrix in every direction. Sometimes, as observed by Mr. C. S. Wilkinson at a mine near Wagga Wagga, the plates are so exceedingly thin that they form mere films like gold-leaf, and in this particular instance the films run both between and across the laminæ of the red-coloured slate in which they occur. Then again, gold occurs in New South Wales, as elsewhere, so finely divided and equally diffused throughout the matrix as to be invisible even by the aid of a lens.

As alluvial gold it occurs in more or less rounded and water-worn flattened grains, scales, and pebbles or nuggets. The largest nuggets discovered in Australia have been found in Victoria, none at all to compare with them in size have been in New South Wales.

Examples of New South Wales Nuggets.

No. 1. Found in July, 1851, by a native boy, amongst a heap of quartz, at Meroo Creek or Louisa Creek, River Turon, 53 miles

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from Bathurst, and 29 miles from Mudgee, New South Wales. It was in three pieces when discovered, though generally considered as one mass. The aboriginal who discovered these blocks "observed a speck of some glittering substance upon the surface of a block of the quartz, upon which he applied his tomahawk, and broke off a portion." One of the pieces weighed 70 lbs. avoir., and gave 60 lbs. troy of gold; the gross weight of the other two about 60 lbs. each. These three pieces, weighing $1\frac{3}{4}$ cwt., contained 106 lbs. troy of gold, and about 1 cwt. of quartz. In the same year another nugget, weight 30 lbs. 6 ozs., was discovered in clay, 24 yards from the large pieces; and in the following year, also near to No. 4, there were found two nuggets, weighing 157 ozs. and 71 ozs.

Gross weight (troy), 106 lbs.; 1,272 ozs.

No. 2. A model of what is said to be the first large nugget found in New South Wales is to be seen in the Australian Museum, Sydney. Found in Ophir Creek.

No. 3. A nugget weighing 26 ozs. was found at Bingera in 1852.

No. 4. Found by a party of four, on 1st November, 1858, at Burrandong, near Orange, New South Wales, at a depth of 35 ft.; when pounded with a hammer it yielded 120 lbs. of gold, for which £5,000 were offered. Melted at the Sydney Mint, when it weighed 1,286 ozs. 8 dwts.; after melting, 1,182 ozs. 7 dwts.; loss, 8 per cent.; fineness, 87·4 per cent.; the standard weight of gold being 1,127 ozs. 6 dwts. Value, £4,389 8s. 10d. The gold was mixed with quartz and sulphide of iron (mundic). Assay, 87·40 per cent. gold = 20 car. $3\frac{7}{8}$ car. grs.

Gross weight (troy), 107 lbs. 2 ozs. 8 dwts.; 1,286 ozs. 8 dwts.

No. 5. Found at Kiandra, Snowy River, New South Wales, October, 1860.

Gross weight (troy), 33 lbs. 4 ozs.; 400 ozs.

No. 6. "The Brenan Nugget." Found in Meroo Creek, Turon River, New South Wales, embedded in clay; measures 21 inches in circumference. It was found 24 yards from No. 1. Sold in Sydney, 1851, for £1,156.

Gross weight (troy), 30 lbs. 6 ozs.; 364 ozs. 11 dwts.

No. 7. Found at New Chum Hill, Kiandra, Snowy River, New South Wales, July, 1861.

Gross weight (troy), 16 lbs. 8 ozs.; 200 ozs.

No. 8. Found at Kiandra, Snowy River, New South Wales, March, 1860.

Gross weight (troy), 13 lbs. 4 ozs.; 160 ozs.

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No. 9. Found, in 1852, at Meroo Creek, Turon River, New South Wales, close to No. 1. This was called "The King of the waterworn Nuggets."
Gross weight (troy), 13 lbs. 1 oz.; 157 ozs.

No. 10. Found in 1860, at the Tooloom Diggings, New South Wales; nearly solid gold.
Gross weight (troy), 11 lbs. 8 ozs.; 140 ozs.

No. 11. Found at Kiandra, Snowy River, New South Wales, March, 1860.
Gross weight (troy), 7 lbs. 9 ozs. 18 dwts.; 93 ozs. 18 dwts.

No. 12. Found in 1852, at Louisa Creek, New South Wales; a solid lump of gold.
Gross weight (troy), 6 lbs. 10 ozs.; 82 ozs.

No. 13. Found by two boys, in July, 1861, at Gundagai (new diggings), New South Wales.
Gross weight (troy), 5 lbs. 4 ozs. 7 dwts.; 64 ozs. 7 dwts.

No. 14. Found in 1857, at Louisa Creek, New South Wales; gold and crystallized quartz.
Gross weight (troy), 4 lbs. 2 ozs.; 50 ozs.

No. 15. Found at New Chum Hill, Kiandra, New South Wales, in July, 1861.
Gross weight (troy), 3 lbs. 6 ozs.; 42 ozs.

No. 16. Found at Summer Hill Creek, New South Wales. The earliest nugget found in New South Wales after the gold discovery there by Hargraves. 13th May, 1851.
Gross weight (troy), 1 lb. 1 oz.; 13 ozs.

No. 17. A nugget weighing 22 ozs. 18 dwts. 12 grains was found recently on "M'Guiggan's Lead," about 9 miles from Parkes; the metal was of dark colour and free from gangue.

No. 18. A nugget weighing 19 ozs. 12 dwts. was found early in 1876, at the "Wapping Butcher" Mine, near Parkes.

For the accounts of Nos. 1 and Nos. 4 to 16 I am indebted to Mr. Brough Smyth's *Gold Fields and Mineral Districts of Victoria.*

In colour most of the New South Gold is usually of fairly deep yellow, being rather lighter than Victorian and not so light as much of the Southern Queensland gold, but occasionally specimens of very pale and of very dark gold are met with. The quantity of silver present greatly affects the colour of the metal.

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In specific gravity it varies considerably, the mean being about 17·5.

A specimen of Braidwood gold had a specific gravity of 18·28.

Composition.—No specimens of actually pure gold have been met with. There is always more or less silver present, and usually traces of copper, iron, and other metals.

PER CENTAGE of silver, copper, and iron in New South Wales Gold. Determinations made at the Sydney Mint, December, 1854.

Gold Field:	Mean of No. of specimens.	Silver.	Copper and Iron.
Tambaroora.....	14	4·735 to 7· 64	Trace to ·125
Turon	8	4· 29 to 8· 37	,, · 13
Meroo	5	3· 86 to 5·005	,, ·105
Mookerawa	1	5·69	,, · 03
Ophir	1	5·93	Other metals ·01
Adelong	5	5·115 to 6·665	,, ·015 to ·13
Araluen, Major's Creek	2	5· 05 to 6· 49	
Araluen, Bell's Paddock	1	10·345	
Bingera, nugget 4 oz. 3dwts.	1	12·525	
Hanging Rock, Oakenville Creek	1	6·295	
Hanging Rock, Cordillera Gold Company, Peel River	1	9·325	
Rocky River	1	5· 63	

From the above average the average value was 80/6 per oz., the value of the standard oz. being 77/10½d. For the materials of the above table I am indebted to Dr. Smith.

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TABLE showing the proportion of gold and silver in characteristic samples of gold dust, from various localities in New South Wales, after melting. By F. B. Miller, F.C.S., late Assayer in Sydney Branch of the Royal Mint.

Locality.	Gold in 1,000 parts.	Silver in 1,000 parts.
NORTHERN.		
Boonoo Boonoo	854 to 659	337 to 298
Fairfield	872	121
Timbarra	708 to 898	280 to 97
Peel River	929	67
Rocky River	934 to 962	61 to 33
Nundle	923 to 937	66 to 63
WESTERN.		
Bathurst	827 to 903	164 to 92
Sofala	929 to 933	66 to 63
Tuena	943	54
Ophir	915	82
Tambaroora	943 to 954	54 to 42
Turon	918 to 928	78 to 68
Hargraves	915	83
Windeyer	946 to 959	53 to 37
SOUTHERN.		
Burrangong	948	48
Adelong	946 to 951	52 to 45
Braidwood	928 to 934	67 to 62
Emu Creek	971	27
Delegate	971	27
Nerrigundah	983	15

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SAMPLES OF GOLD characteristic of the Gold Fields of New South Wales, exhibited by the Mining Department, and assayed at the Royal Mint, Sydney. From the New South Wales Official Catalogue, Philadelphia Exhibition, 1876.

Locality.	Description of Gold.	Weight of Sample.	Loss in melting per cent.	Gold and Silver in 1,000 parts, after melting.		Value per oz., after melting, at £3 17s. 10½d., Standard.		
WESTERN DISTRICT.		Ozs.		Gold.	Silver.	£	s.	d.
Sofala	In fine scales, and coarse plates and grains	2·50	1·54	923·0	72	3	18	9½
Bathurst	Fine scales and coarse grains, with some spongy and stringy	2·00	2·00	923·5	71	3	18	10
,,	Fine scales, plates, and coarse grains	2·00	1·47	918·0	76	3	18	4½
Hargraves	Fine dust and coarse grains	2·00	1·23	920·5	70	3	18	6½
,,	Scaly with some grains	2·00	1·15	961·0	33	4	1	9½
Tambaroora	Fine and coarse scaly and grains	2·00	1·31	940·0	54	4	0	1
,,	Fine scales and grains	2·00	1·55	943·5	50	4	0	5
,,	Reef gold; reticuled	2·00	2·77	944·5	51	4	0	6
,,	Coarse waterworn grains or nuggets	2·00	2·00	935·5	54	3	19	8½
Hill End	Fine dust and coarse grains	2·00	2·47	945·5	47	4	0	7
,,	Scaly, with coarse spongy grains	2·53	1·41	945·5	50	4	0	7
,,	Fine scales and coarse crystaline gold	2·00	2·18	947·0	47	4	0	8½
,,	Scaly and coarse filiform gold	2·00	1·97	942·5	49	4	0	4
Mudgee	Fine scales and coarse grains	2·50	1·93	941·0	56	4	0	2½
,,	Coarse grains with some scales	2·00	2·04	926·0	68	3	19	0
,,	Fine and coarse scales	2·00	1·77	937·0	58	3	19	10½
Gulgong	Coarse spongy grains and some scales	2·00	1·78	938·0	58	3	19	11½
,,	Dust and coarse scales	2·00	1·78	916·5	79	3	18	3
,,	Coarse pieces—filiform and spongy	2·00	1·78	925·0	70	3	18	11
,,	Scaly, with some grains	2·00	1·59	946·0	48	4	0	7½
Carcoar	Fine scales, very porous. with some magnetic iron	2·00	10·92	878·0	119	3	15	2
,,	Fine and coarse filiform gold of a dark colour	2·00	2·94	960·0	36	4	1	8½
Orange	Scaly	2·00	2·67	943·0	51	4	0	4½
,,	Fine dust—"gunpowder gold"	2·00	2·53	930·5	62	3	19	4
Stony Creek	Scaly	2·00	1·56	942·0	54	4	0	3½

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SAMPLES OF GOLD—*continued.*

Locality.	Description of Gold.	Weight of Sample.	Loss in melting per cent.	Gold and Silver in 1,000 parts, after melting.		Value per oz., after melting, at £3 17s. 10½d., Standard.		
SOUTHERN DISTRICT.		Ozs.		Gold.	Silver.	£	s.	d.
Braidwood	Plates and fine scaly	2·00	1·79	959·0	34	4	1	7½
Araluen	Fine dust—"gunpowder gold"	2·00	2·19	951·5	42	4	1	0½
Adelong	Fine scaly and coarse filiform	2·00	2·63	944·0	52	4	0	5½
,,	Scaly	2·00	1·27	941·0	53	4	0	2
,,	Coarse filiform with some scaly	2·50	1·69	946·0	50	4	0	7½
Tumut	Fine and coarse, with some very spongy	2·00	6·28	927·5	70	3	19	1½
Young	Scaly dust gold	2·00	2·39	957·0	36	4	1	5½
,,	Fine dust—"gunpowder gold"	2·00	1·52	943·0	49	4	0	4½
Nerrigundah	Strings, scales, and plates	2·50	1·64	980·5	15	4	3	4½
Kiandra	Scales and plates with some grains and threads	2·00	3·15	927·0	63	3	19	1
Goulburn	Coarse grains and reticulated	2·00	6·87	975·0	22	4	2	11½
Bombala	Very five scaly dust—"gunpowder gold"	2·00	2·63	963·0	34	4	1	11½
Cooma	Filiform crystaline and some scaly	2·00	3·17	938·0	56	3	19	11½
,,	,, ,,	2·00	4·22	924·0	70	3	18	10
NORTHERN DISTRICT.								
Nundle	Fine scaly and coarse filiform	2·00	3·33	919·5	73	3	18	6
,,	Scales, plates, and coarse filiform; of a brownish colour	2·00	3·28	902·5	90	3	17	1½
Tamworth	Spongy, filiform, and crystaline, some with a little quartz attached.	2·00	3·28	912·0	83	3	17	10½
,,	,, ,, ,, ,,	2·00	3·31	914·0	80	3	18	0½
,,	Fine dust and shotty grains	2·00	3.31	899·5	93	3	18	10½
Armidale	Scales with some threads	2·00	3·30	948·0	44	4	0	9
,,	Fine scales	2·00	1·91	888·5	105	3	16	0

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The average fineness of Victorian gold is about 23 carats, that is to say, it contains about 96 per cent. gold and 3½ per cent. of silver, with about ½ per cent. of other metals. Further north, in New South Wales, the average fineness is 22 carats 1⅞ grains, or 93½ per cent. gold and 6 per cent. silver. Still further north, in Queensland, the average fineness is but little more than 21 carats, or 87·25 per cent. gold, 12 per cent. silver. Maryborough gold only contains 85 per cent. gold and as much as 14 per cent. silver. (*F. B. Miller, F.C.S. Trans. Roy. Soc., N.S.W.*, 1870.)

The Palmer gold, from Northern Queensland, is much richer than any of the specimens from Queensland referred to above.

Vein gold.—The greater portion of the gold found *in situ* in New South Wales occurs in quartz veins running through the older and metamorphic rocks. It is also said to occur under similar circumstances in true igneous rocks. Calcite is occasionally the vein-stuff.

The rocks in which auriferous veins are most commonly met with are the various argillaceous slates, and chloritic and talcose schists; also in granite, as at Braidwood and Bowenfells, porphyries, and other similar metamorphic rocks; in Eisenkiesel, at Carcoar. The walls and "country" of such veins are also usually auriferous to greater or less distances.

As examples of the richness of portions of gold veins, the following may be cited:—A telegram from Hill End, on February 1st, 1873, stated that at Beyers & Holtermann's mine 100 cwt. of gold had been raised in 200 cwt. of stuff. From the same mine a slab of vein-stuff and gold weighing 6½ cwt. was exhibited which was estimated to contain about 2 cwt. of gold. Many other similarly rich blocks were also shown.

The Mint returns for the gold from 415 tons of vein-stuff from this mine were 16,279·63 ozs., value £63,234 12s.

Krohmann's Company, also at Hill End, raised 436 tons 9 cwt. of stuff, for which the mine returns were 24,079 ozs. 8 dwts. of gold, value £93,616 11s. 9d.

Gold reefs in New South Wales have not yet been worked to any great depth. At Adelong they are getting good stone from a depth of 530 feet.

Associations.—The most common minerals which are found with vein gold are iron pyrites, which is never quite free from, and is sometimes exceedingly rich in gold; iron oxide, which is for the most part derived from the decomposition of various pyrites; mispickle, in calcite, as at Lucknow, where the mispickle contains in parts over 200 ozs. of gold per ton; with mispickle at Carcoar, and at Moruya with silver sulphides also; with pyrrhotine and calcite, as at Hawkin's Hill; with galena, zinc, blende, magnetite, molybdenite, chlorite, talc, asbestos, steatite; cuprite, malachite,

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and other copper ores, notably in the Wellington and Adelong districts; it is reported with tin in the cliffs at Eden, and with native arsenic at Solferino.

In alluvial deposits gold is associated in New South Wales with a very large number of minerals; and it is remarkable that certain of them such as platinum, osmo-iridium, sapphire, ruby, oriental emerald, and diamond, have not yet been found *in situ*. Amongst the others we have tinstone, titaniferous iron, magnetic iron, chromic iron, brookite, rutile, anatase, emerald, beryl, topaz, zircon, hyacinth, spinelle, garnet, red and brown hæmatite, pyrites, binoxide of manganese, galena, blende, tourmaline, magnesite, and many more of less value.

The alluvial deposits are of various ages, but none of them probably are older than late Tertiary age, and are often deeply buried by overflows of igneous rocks.

Gold is found in small quantities in the tin-drifts of New England, especialy in the older drifts, conglomerates or "cements" as they are termed by the miners.

The Rev. W. B. Clarke mentions that gold is found at the mouth of the Richmond River distributed in the sand and covering pebbles on the sea beach—a similar distribution is found in the sand of Shell Harbour. Other spots give similar indications, and some specimens of gold were brought up from the sea-bottom by the sounding apparatus of H.M.S. "Herald" off Port Macquarie.

Distribution.—From the fact that gold is so widely scattered over nearly the whole of New South Wales, it would be almost an endless task to attempt to enumerate the names of all the localities at which it has been found, it must therefore suffice to refer you to the names of the principal gold fields, already cited in the tables which show the proportion of silver contained by gold from various parts of the Colony, and to the mineral map published by the Government, which roughly shows the approximate area of the various gold fields.

Amount.—The total quantity of gold as recorded in the Government returns from 1851 to 1874 was 8,205,232.598 ozs., and the value £30,536,246 10s. 6d. A model in the form of a huge parallelopipedon, measuring 6 ft. 6 inches square in the base and having a height of 11·1 feet, representing this amount of gold, is now at the Centennial Exhibition in Philadelphia,—the calculation for the above dimensions being based on the assumption that the average specific gravity of the gold was 17·5.

The Discovery of Gold.—It is beyond my province to express any opinion upon the long disputed question as to who was the original discoverer of gold in Australia; but it may not be out of place to quote certain statements which have been made from time to time, so that each may judge for himself.

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The *Evening News* of Sydney for 7th August, 1875, contains the following statement with respect to the original discovery of gold:—"We are in a position to show that gold was discovered, and we believe officially reported to the Government, upwards of fifty-two years ago, viz., on the 16th February, 1823. On that date, Mr. Assistant-Surveyor James M'Brian discovered the precious metal at a spot on the Fish River, about midway between O'Connell Plains and Diamond Swamp, a little to the north of the old Bathurst Road, and about 15 miles east of Bathurst. We have now before us an extract from Mr. M'Brian's field book, which book is preserved in the Surveyor General's Office. It reads as follows:—'February 16, 1823. At 81·50 to river, and marked gum-tree. At this place I found numerous particles of gold in the sand and in the hills convenient to the river.' It is possible but hardly probable that other persons may have discovered gold before that date, and that owing to the then peculiar social condition of the Colony, arising from the presence of a large prison population, it was thought best to suppress the knowledge of the fact."

It is stated that Count Strzelecki found gold, associated with pyrites, in 1839, in the Vale of Clwydd.

With reference to the most important part which the Rev. W. B. Clarke played in the discovery of gold in Australia, I cannot do better than quote the words of one of England's most eminent geologists.

Professor Geikie, in his "Life of Murchison," says:—"Count Strzelecki appears to have been the first to ascertain the actual existence of gold in Australia; but, at the request of the Colonial authorities, the discovery was closely kept secret. The first explorer who proclaimed the probable auriferous veins of Australia on true scientific grounds, that is, by obtaining gold *in situ* and tracing the parent rocks through the country, was the Rev. W. B. Clarke, M.A., F.G.S., who originally a clergyman in England has spent a long and laborious life in working out the geological structure of his adopted country, New South Wales. He found gold in 1841, and exhibited it to numerous members of the Legislature, declaring at the same time his belief in its abundance. While therefore geologists in Europe were guessing, he, having actually found the precious metal, was tracing its occurrence far and near on the ground."

In 1844, Sir Rod. Murchison pointed out the singularity of the Blue Mountain Chain of Australia (the Cordillera) to that of the Ural, and predicted the occurrence of gold; this seems to have turned out a happy guess, but it cannot be wholly considered as a scientific declaration. His prognostications, 1844–6–7 (appear) however, to have been the first published.

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On June 23rd, 1875, some articles and letters referring to the discovery of gold appeared in the *Parkes Gazette*, in which it is stated that Mr. John Phillips announced the discovery of gold in 1847. A letter, dated from Jermyn-street, 16th July, 1855, from Sir Rod. Murchison to Sir Chas. Hotham, is cited, which states that "Mr. Phillips is the person who first announced to me that he had detected it (gold) in your government (1847). I so stated the fact in my letter of 1848 to the Colonial Secretary, Lord Grey, when I urged upon H. M. Government to take the initiative in developing the auriferous resources of the region."

To Mr. Hargraves in 1851 was reserved the satisfaction of showing that gold existed in great quantities in various parts of the Colony and how it could be readily obtained from alluvial deposits by means of the cradle.

Silver.

Native Silver.

Native silver does not appear to have been found *in situ* in New South Wales.

The Rev. W. B. Clarke mentions in his "Southern Gold Fields," that silver has been met with in the Southern Districts in two or three places in the form of small fragments and arborescent crystals. The same author mentions finding a thin plate of flexible silver having a sp. gr. of 10.

Strzelecki found traces of silver in the western country in 1839.

Silver glance.

Chem. comp.: Sulphide of silver = Ag_2S. Silver, 87·1; S, 12·9 = 100. Cubical system.

This ore has been found with iron pyrites in quartz, also in limestone on the Clarence River, and on the Manning River. At two or three places near Bathurst, at Copper Hill on the western side, and at Brownlea; on the Page and Isis Rivers; at Brunaby Creek, county Argyle; at Broulee, Moruya, with cobalt, zinc, and iron; Teesdale, Co. Bathurst; Queanbeyan River, Burra Creek, Yass River; Buckinbah; Tacking Point, Co. Macquarie; Borrowa Creek; Crookwell River; with gold, lead, and zinc at Gulgong; with carbonate of lead at Peelwood; with galena and iron pyrites at Shellmalleer; on the Molonglo River, near junction with the Murrumbidgee, and at junction of Murrumbidgee Creek with Mountain Creek. In nearly all cases the silver sulphide occurs mixed more or less intimately with galena, so that properly it should usually be termed argentiferous galena.

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ANTIMONIAL SILVER ORE.

Containing arsenic, at Moruya. (See specimen in the Australian Museum.)

Platinum.

NATIVE PLATINUM.

Reported to occur with gold in the Shoalhaven River, and in the Ophir gold district—in the form of small grains, Bendemeer.

Osmium Iridium.

OSMO-IRIDIUM.

This compound of osmium and iridium is very commonly met with in the auriferous and other drifts of New South Wales in the form of minute grains and scales.

I have observed it in the gem-sand at Bingera, Mudgee, Bathurst, and other places.

Its presence in alluvial gold is occasionally a source of trouble at the Mint, for minute grains are often mechanically enclosed by the gold after melting, which by their hardness speedily destroy the dies during the operation of coining.

Mercury.

NATIVE MERBURY.

In the Mookerawa Creek and in Great Waterhole at Ophir, mentioned by Stutchbury, and he states that mercury had never been used on that creek.

CINNABAR.

Chemical composition: Mercury, sulphide = HgS. Found on the Cudgegong River in an argillaceous matrix, and in alluvial deposits associated with gold, gems, and other similarly occurring minerals, in the form of small rounded masses of a brilliant red colour. Reported to occur also at Moruya.

Copper.

NATIVE COPPER.

Cubical system. Crystallized native copper is by no means rare, but large and well developed crystals as elsewhere are uncommon. It is met with massive, in plates, threads, wires, and arborescent forms, the latter being usually built up of elongated rhombic dodekahedra.

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I have been unable to find any analysis of New South Wales native copper, but it probably contains the usual small quantities of silver, lead, bismuth, and other metals.

In nearly all cases it is found in association with cuprite, malachite, and other oxidized copper ores, as at Carcoar, the Canobolas, Wellington, Mitchell's Creek, Bathurst, Pink's Creek, Bell River, Peel River, Manilla, Bingera, Cobar. It occurs in smaragdite on Molong Creek, at Peelwood with lead ores. The late Mr. Stutchbury reports that at Kelloshiels the well-water was found to be so impregnated with copper as to be unfit for domestic purposes.

Cuprite.

Chem. comp.: Copper suboxide = Cu_2O. Copper, 88·8 oxygen, 11·2 = 100.

Usually found massive, but occasionally well crystallized, in cubes and octohedra, which, however, are seldom more than $\frac{1}{4}$ inch in diameter.

Chalcotrichite, or Plush Copper: The variety crystallized in capillary crystals, met with at the Coombing Mine near Carcoar. The best crystals which I have seen have come from the Cobar Mine.

This mineral is usually associated with the other oxidized copper ores, such as malachite and chessylite.

It is abundant at Cobar, both massive and crystallized; Clarence River, Cowra, Bathurst district, Mitchell's Creek, Wiseman's Creek, Carcoar, Icely, Burrowa, Molong; Manilla, with grey sulphide or redruthite; Bungonia, Yass; Peelwood, with tenorite; Bingera.

Tenorite.—Melaconite.

Or Black Oxide.—Chem. comp.: Copper oxide = CuO. Copper, 79·85; oxygen, 20·15 = 100.

Usually in the form of a black powder, massive, or sporadic, *i.e.*, disseminated in nests. Usually found associated with other oxidized copper ores, as at Carcoar, Wellington, Icely, Peelwood, Burrowa.

Malachite.

Green Carbonate of Copper.—Chem. composition: Hydrous Copper Carbonate = $Cu_2CO_3 + H_2O$. CuO, 71·9; carbonic acid, 19·9; water, 8·2 = 100. Metallic copper, 57·5.

Oblique system. Colour from pale emerald to deep green. Occurs massive, also mammillated and botryoidal with fibrous concentric structure, the various layers often possessing different shades of colour and forming a most beautiful and valuable stone for ornamental and inlaying purposes. Crystals are occasionally met with, and sometimes of large size; those from the Cobar Mines are particularly beautiful. The silky lustre is often very remarkable, the capillary crystals sometimes being several inches long.

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It is found in most of the surface workings of New South Wales copper mines, as in the Bathurst district with chlorite, vitreous, yellow, and other copper ores; at Cambalong earthy and fibrous malachite is associated with barytes or heavy spar, and with yellow and peacock ore; at Cobar, with steatite; Mitchell's Creek, Wellington, mixed with other surface ores, and often containing large quantities of gold and silver; Reedy Creek, Icely, Peelwood, Yass, Bingera, and other places.

Chessylite.

Azurite, or Blue carbonate of copper.

Chem. comp.: Hydrous copper carbonate. $2\,CuCO_3 + Cu H_2O_2$. Copper oxide, 69·2; carbonic acid, 25·6; water, 5·2 = 100. Oblique system. Colour from azure to indigo blue, translucent to opaque.

Found massive and crystallized. The best specimens of the latter come from the Cobar Mines. They often assume a radiated concretionary form, with the terminal planes of the crystals studding the surface of the balls in the form of small projections. These concretions vary from almost imperceptible points up to balls several inches in diameter, and as they often occur diffused through a pale grey or green coloured steatitic clay they present an extremely pretty appearance; at other times the crystals are set off by a dazzling white felspathic clay. Well developed crystals are also found lining vuggy cavities.

At Cobar chessylite is associated with atacamite in addition to the other more commonly occurring ores.

At Woolgarloo chessylite occurs with native copper, cuprite, and malachite in pink and white fluor spar. This mixture has at times a very pretty effect, from the manner in which the copper minerals are diffused through the cracks and reticulating cavities in the fluor spar. Something of the same sort of thing is to be seen in the fluor spar from South Wiseman's Creek.

Amongst other localities for chessylite are Inverell, in quartz veins; Bathurst, Peelwood, Icely, and Ophir.

Atacamite.

Chem. composition: Hydrous oxychloride copper = $3CuH_2O_2 + CuCl$. Copper oxide, 53·6; copper chloride, 30·2; water, 16·2 = 100. Rhombic system. Dark green in colour.

Occurs in the Cobar and Cowra copper mines.

Chryscolla.

Chemical composition: Hydrous copper silicate = $CuSiO_3 + 2H_2O$. Copper oxide, 45·3; silica, 34·2; water, 20·5 = 100. Amorphous. In colour, dark-green.

Reported to occur in a matrix of semi-opal at the Coombing Copper Mine, 2 miles from Carcoar. Also occurs at Cobar.

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Phosphocalcite.

Pseudomalachite.—Chem. Comp: Hydrous copper phosphate $= Cu_5P_2O_{10} + 3H_2O$. Copper oxide, 67·0; phosphoric acid, 23·9; water, 9·1 = 100. Rhombic system. Colour, dark-green.

Coombing Copper Mine.

Arseniate of Copper.

Mentioned as occurring in a quartz vein on the Cox River, but it is not stated whether the mineral was condurrite, olivenite, or one of the other arseniates.

The next group of copper ores comprises the various Sulphur Compounds of Copper.

Redruthite.

Erubescite, vitreous copper ore, copper glance.

Chem. comp: Copper disulphide = Cu_2S. Copper, 79·8; sulphur, 20·2 = 100. Rhombic system.

I have only seen this mineral in the massive state, but it is found crystallized in South Australia. It is of a lead-grey colour, soft, and leaves a shining streak.

Found at Cobar; Manilla waters, near Bowral; near the Wellington Caves, with blue and green carbonates in a quartzose vein-stuff; also at Wellbank, near Wellington; at Cardiangullong Creek, with iron pyrites; at Bathurst, Kroombit, Icely, Carcoar.

Bornite.

Purple ore, Buntkupfererz.

Chem. comp: = $(Cu_2\ Fe)\ S_2$. Varies considerably.

Copper, 56 to 70; iron, 6 to 17; sulphur, 21 to 26.

Cubical system; colour, copper red, purple to brown; massive; fracture, even to small conchoidal; streak blackish-grey, shining.

Found at Cobar; Bingera; Wellbank, Wellington District.

Fahlerz.

Grey Copper Ore. Tetrahedrite.

Chem. comp.: $4CuS + Sb_2S_3$ but variable.

Part of the copper often replaced by iron, zinc, silver (up to 30 per cent.), mercury, or cobalt; and the antimony partly replaced by arsenic and occasionally bismuth.

Cubical system, usually in tetrahedral forms—hence one of its synonyms; colour, grey; soft, cuts with shining streak.

Occurs on the west side of Copper Hill, near Molong.

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Chalcopyrites.

Copper pyrites. Chem. Comp.: Copper-iron sulphide Cu_2S, Fe_2S_3. Copper, 34·6; iron, 30·5; sulphur 34·9 = 100. Tetragonal system; hemihedral forms. A very abundant ore.

Usually occurs massive; occasionally crystals are met with, but they are generally but imperfectly developed. Colour, usually brass yellow. Blister ore is more of a bronze colour, and occurs in mammillated and botryoidal forms. The tarnished variety of copper pyrites, known as peacock ore from the splendid colours which it acquires, is very common.

It occurs in nearly all the metalliferous districts in the Colony: at Cobar, Bingera, Elsmore, Clarence, Wiseman's Creek; Wellington and Bathurst districts, with zinc blende, steatite, quartz, and asbestos; Wallabadah, Carcoar, Cargo, Ophir, Peelwood, Tuena, Bungonia; at Currowang, on the Shoalhaven; Adelong, with gold; at Lob's Hole on the Tumut; Kiandra.

Bell-metal Ore—Cobar.

Domeykite.

Arsenical Copper Sulphide. Chem. Comp.: Copper arsenide, Cu_3As. Copper, 71·7; arsenic, 38·3 = 100.

Amorphous. Occurs in the Bathurst District with yellow sulphide of copper.

Antimonial Copper Ore.

Said to occur at Eden, Twofold Bay.

Dioptase, olivenite, liebethenite, bournonite, and other beautiful copper minerals have apparently yet to be found.

Iron.

Native Iron.

Out of a large number of specimens of so called native iron which have come before me from time to time, not one was entitled to be so called; they had all without exception been derived from iron and steel tools.

Native iron, apart from that derived from meteorites, however, probably does occur in the Colony, and it is most likely to be found in or near to igneous rocks, *e.g.*, melted globules of native iron have been met with at Ballaarat in Victoria in connection with basalt.

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MAGNETITE.

Magnetic Iron Ore. Chem. Comp.: Iron oxide = $Fe_3 O_4$. Iron, 72·4; oxygen, 27·6 = 100. Cubical system.

This is the richest of all the ores of iron, and when perfectly pure it only contains rather more than 72 per cent. of metallic iron; hence the absurdity of the statement so commonly made that the iron ores on a certain property contain over 90 per cent. of metal will be at once apparent; and moreover, it is a very rare thing indeed for large masses of any ore to be quite pure, therefore, instead of the amount of metal in the vaunted mineral even approaching to that quantity it falls far below it, and most probably it is much nearer 50 than 90 per cent.

It is found in the Colony both massive and crystallized in octohedra, which are usually small. In structure it varies, being compact, granular or lamellar.

Large deposits of magnetite exist at Wallerawang; Mount Lambie, in a chloritic matrix; Mount Wingen; Solferino in quartz veins; Grafton with copper ores; on the Clarence and the Shoalhaven.

A lamellar magnetite of good quality occurs in quartz at Carcoar associated with iridescent botryoidal brown hæmatite, and at Combullanarang with copper ores.

It is also found at Inverary Quarry, where Stutchbury mentions that it occurs in the pisolitic form, associated with a black non-magnetic ore in rounded particles the size of peas, and cemented together by a variety of crystallized minerals. Crystallized and compact magnetite occurs near the limestone quarries on Belubula Creek. Rounded and polished nodules of magnetic iron ore occur in the Lachlan River with ilmenite; it is also found in nearly all the gold and gem bearing drifts and deposits.

HÆMATITE.—Specular Iron.

Red Hæmatite, Specular Iron. Chem. comp.: Iron oxide $Fe_2 O_3$. Iron, 70; oxygen, 30 = 100.

Hexagonal system, in rhombohedral forms. Usually massive, platy, or micaceous. Well-formed crystals are almost unknown here. Specular iron ore occurs in a coarse-grained granite at Summer's Hill, near Bathurst, and at Mount Lambie; also at Bookham and Yass, with micaceous and massive red hæmatite; micaceous hæmatite also occurs at Pine Bone Creek, with titaniferous iron.

Of the hæmatite near Carcoar, the late Mr. Stutchbury speaks as follows:—"In a gully or creek called the Waterfall Creek, running into the Cardiangullong Creek, and at the extremity of a mountain spur known as the Rocky Ridge, there is an immense mass of oxydulous iron (hæmatite) forming in one solid mass a precipitous waterfall of about 60 feet in height; in this mass of

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iron, especially in the joints, there are brilliant crystals of iron pyrites, with a small quantity of yellow copper ore and traces of blue and green carbonate of copper. Here also is found iron sulphate, from the docomposition of the pyrites."

In the cliffs at Shepherd's Hill, Newcastle, there are trunks of trees converted into red hæmatite.

Large deposits of massive and somewhat ochry red hæmatite occur at Brisbane Water, also over large areas in the County of Argyle. This same mineral enters largely also into the composition of the so-called "red hills" occurring in the New England tin districts and other parts. A silicious red hæmatite is also common in the Hawkesbury sandstone, about Sydney, and elsewhere, as veins and scattered nodules.

One of these nodules which I examined contained 28·0 per cent. of metallic iron, and the compact red hæmatite from Nattai gave me 45 per cent.

Goethite.—Brown Hæmatite.

Chem. comp.: Hydrated sesquioxide of Iron = $Fe_2O_3,3H_2O$. Iron sesquioxide, 89·9; water, 10·1 = 100.

Generally massive, or with fibrous radiate structure, minute velvety crystals are sometimes met with; also scaly, mammillated, pisolitic, reniform, and stalactitic.

Externally the colour is often jet-black with high lustre; within yellow, yellowish-brown, and full-brown. Streak, brown.

Many of the nodules of brown hæmatite contain cavities and hollows holding a soft black substance like binoxide of manganese, which hardens on exposure.

Very large and extensive irregular deposits and pockets of brown hæmatite occur at Wallerawang, Jamberoo, Nattai, Port Hacking, the Murrumbidgee, Mt. Tellula, and many other places, such as between Mt. Tomah and Mt. King George. In fact this mineral is one of the most widely diffused.

A specimen of Brown Hæmatite, from Wallerawang, yielded the following results on analysis:—

Water, hygroscopic	1·28	
„ combined	12·04	
Silica and insoluble matter...	12·19	
Sesquioxide of iron	73·60	= 51·2 per cent. metallic iron.
Phosphorus	·12	
Sulphur	·06	
Undetermined	·71	
	100·00	

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Limonite.

A variety of brown hæmatite. Large stalactites are formed by the ferruginous springs at Berrima, Nattai, and elsewhere, and the deposits of brown iron from these often contain beautiful impressions of leaves and other objects; also in botryoidal and mammillated forms.

Extensive deposits of what are termed *Clay Band* iron ores occur interbedded with the coal measures. These form an earthy variety of brown hæmatite; yet they are often very rich, and as they occur in immense quantities in close association with coal, they form a most valuable source of iron.

A specimen from Wallerawang yielded the following results:—

Water, hygroscopic	1·28	
„ combined	3·54	
Silica and insoluble matter...	4·60	
Sesquioxide of iron	80·00	= 56 per cent. metallic iron.
Phosphorus	·49	
Sulphur	·11	
Undetermined constituents..	9·98	
	100·00	

Specimens from two other seams in the same locality yielded 49·28 and 53·31 per cent. of metallic iron respectively.

Similar clay bands occur at Jamberoo; in the Buttar Ranges, near to East Maitland; at Mount Wingen, and elsewhere.

Pisolitic Iron Ore—Is another of the less pure forms of Hæmatite. Large superficial deposits of pisolitic and brecciated iron ore, red and brown, occur near Bungonia and Windellama Creek, and overlie the slate more or less continuously between Bungonia, Jacqua Creek (with limestone), Dog Trap, and Spring Creeks, forming what are known as the "Made Hills."

The "Made Hills" which lie between the Macintyre River and Cope's Creek are composed of the same material.

A pea-iron ore occurs in the coal at Nattai, and near Bungonia there is an auriferous argillaceous iron ore. At the Boro Creek, County of Argyle, there is a botryoidal pisolitic ore.

The same variety occurs at Brisbane Water.

Red and Yellow Ochres—Are closely allied to the above Hæmatite iron ores, and are usually found associated with them.

Spathic Iron Ore.—Chalybite.

Siderite, Sphœrosiderite.—Hexagonal system, rhombohedral forms.

Chem. Comp: Iron carbonate = FeCO. Iron oxide, 62·1; Carbonic acid, 37·9.

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Occurs in minute crystals at Gulgong. It is also found at Newstead Mine, New England, with arragonite; in basalt, at Jordan's Hill, Cudgegong River.

Thick bands of grey-coloured impure carbonate of iron, some of which contain about 10 per cent. of metallic iron occur in the coal measures at Jamberoo.

Chrome Iron.—Chromite.

Chem. Comp.: Iron chromate = $FeCrO_4$. Iron oxide, 32·0; chromic acid, 68·0 = 100.

Cubical system: Usually occurs massive, with a granular or lammellar structure. Black in colour, and in small crystals and water-worn grains in gold and gem bearing sands.

In the Gwydir River and many of its tributaries, in Nundle Creek, Two-mile Creek, the Horton River, Hanging Rock, at Stony Batta with serpentine, Bingera, Reedy, Gundamulda, Kennedy's, and Angular Creeks; also at Mudgee, the Murrumbidgee River, and near Yass.

Scorodite.

Chem. Comp.: An arseniate of iron. Arsenic acid, 49·8; sesquioxide of iron, 34·7; water, 15·5 = 100.

Rhombic system: with iron pyrites, Cadell's Reef, Mudgee Road, 9 miles south-east of Mudgee.

Pharmacosiderite.

Chem. Comp.: Arseniate of Iron. Arsenic acid, 39·8.; phosphoric acid, 2·5; sesquioxide of iron, 40·6; water, 17·1 = 100.

Cubical system.—Found crystallized in small olive-green cubes. Subtranslucent.

Locality.—To the east of Bungonia.

Titaniferous Iron.

Chem. Comp.: Iron and titanium.

There are several different kinds of titaniferous iron, distinguished by their physical properties and by the amounts of titanic acid which they contain—such as ilmenite, iserine, menaccanite, &c. Until those found in New South Wales have been examined, it will it be as well, perhaps, to class them all under the general head of titaniferous iron.

Found usually with alluvial gold, about Ophir, Bathurst, Mudgee, Bingera, and Uralla in the diamond drifts. Large rolled masses occur at Uralla. Ilmenite, menaccanite, nigrine, and iserine are said to occur with gold, garnets, and chrysolites in the Two-mile Flat Creek Cudgegong River, and in the Lachlan with magnetite.

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Iron Pyrites.

Chem. comp.: FeS_2. Sulphur 53·3; iron 46·7 = 100. Crystallizes in the cubical system. Occurs massive and crystallized, the most common forms being the cube and the pentagonal dodekahedron. Well-formed cubes partially decomposed into brown hæmatite are common in many deposits with gold, and are known to the miners by the name of "devil's dice." All specimens of pyrites which I have examined have without exception contained traces of gold, and in some cases large amounts.

As is found to be the case in other parts of the world, this mineral is almost universally diffused throughout the metalliferous districts of the Colony, and is found in rocks of all ages.

Well-formed crystals are found in the Manilla and Namoi Rivers. In the tin district of New England it is very common—Bathurst district; at Gulgong, well-formed pentagonal dodecahedra are common in the auriferous quartz veins. Very abundant in the Adelong reefs; the Carcoar District; at Kiandra, crystallized in cubes with molybdenite.

Marcasite.—Rhombic pyrites. Chem. comp.: Iron sulphide = FeS_2. Same as the former, of which it is an allotropic form.

Fluted rhombic crystals occur with arsenical and common pyrites (auriferous) to the south of Reedy Creek, Shoalhaven River; also at Carcoar, with galena and other minerals.

Pyrrhotine.

Magnetic pyrites. Chem. comp.: Fe_7S_8. Sulphur 39·5; iron 60·5 = 100.

Hexagonal system.

More of a copper-colour than the other pyrites, slightly magnetic, and crystallizes in six-sided forms.

It occurs with gold and calcite at Hawkins Hill.

Nickel.

Kupfernickel.—Copper-nickel.

Chem. Comp.: Nickel arsenide = NiAs., Ni = 44·1 : As = 55·9 = 100.

Hexagonal system: Massive. Of a copper-red colour, in parts incrusted with pale green nickel hydrate. Reported from near Bathurst.

Plakodine.

Arsenical nickel: NiAs., Nickel = 60 per cent.

Found by the Rev. W. B. Clarke, on the Peel River, and to the south-west of Weare's Creek. Yellowish white in colour, highly magnetic. Sp. gr. = 8; H. = 5·5; and dissolving readily in nitric acid.

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Manganese.

The ores of manganese do not appear to have been discovered in any great abundance in New South Wales.

Wad.

An impure oxide of manganese.

At Long Gully, near Bungonia, it is met with having a more or less botryoidal form and platy structure; of a black colour, soft with a black shining streak; in association with quartz, both as small veins running through the quartz and as an external coating or incrustation. A specimen from this locality was found to contain 1·57 per cent. of cobalt, and 0·36 per cent. of nickel (Dr. Thomson.)

It is abundant in the diamond drift near Mudgee, both as a cement and incrustation; often dendritic in outline. The incrustation on many of the pebbles is evidently quite recent.

It is very common as dendritic markings on rocks in many parts of the Colony.

It is found to the north of Cotumba, loose on the ground; also at Orange.

A peculiar form of wad is found in cavities in the basalt at Hill End; this variety is very soft and porous, being composed of minute scales arranged loosely together in a concentric manner—in fact, having a structure similar to that of wood; externally it has somewhat a frothy appearance, with a metallic lustre; so soft that it blackens the fingers, and will hardly bear handling without crushing.

Kupfermanganerz.

Cuprous manganese. Chem. comp.: An impure oxide of manganese, containing a few per cent. of black oxide of copper and oxide of cobalt.

Found in the Coombing Copper Mine, with native copper, cuprite, copper carbonates, and sulphides.

Zinc.

Zinc Blende.

Chem. comp.: Zinc sulphide = ZnS. Found massive, and crystallized in small hemihedral forms belonging to the cubical system. Many of the crystals have beautiful bronze and purple metallic tints.

With tin, gold, manganese, copper pyrites, galena, and other minerals, on Major's Creek, near Bungonia.

With gold, iron, copper pyrites, and asbestos, in a quartz vein, Wiseman's Creek, near Bathurst. Orange

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Lead.

Native Lead.

The Rev. W. B. Clarke more than once mentions having found native lead on the Peel River and elsewhere.

Minium, or Native Red Lead.

Chem. comp.: Lead oxide = Pb_3O_4. Lead, 90·66; oxygen, 9·74 = 100. Occurs with cerussite at Peelwood, near Tuena.

Cerussite.

Chem. comp.: Lead carbonate = $PbCO_3$. Lead oxide, 83·5; carbonic acid, 16·5 = 100. Occurs massive and in large prismatic crystals at Peelwood Mine; on the exterior they are often coloured red by a ferruginous clay. Also found at Tuena in a red clay. At Solferino.

Anglesite.

Chem. comp.: Lead sulphate = $PbSO_4$. Lead oxide, 73·6; sulphuric acid, 36·4 = 100. Said to have been found with galena on the Abercrombie River.

Pyromorphite.

Chem. comp.: Lead phosphate = $3Pb_3P_2O_8$, PbCl. In round numbers, lead oxide, 75·0; phosphoric acid, 15·0; lead chloride, 10 = 100. Small quantities of calcium fluoride and calcium phosphate are usually present.

At Grenfell, it is found as a bright green-coloured powder containing minute hexagonal prisms; it is also found of the same colour associated with galena and mimetite in a vein traversing clay slate, near Bathurst. Another specimen from Bathurst was of a pale greyish-brown colour, with a waxy lustre, and mammillated surface, upon which small crystals of chessylite were seated.

It also occurs on the Sugar-loaf Hill, near Wellington; also on Mitchell's Creek.

Mimetite.—Kampylite.

Chem. comp.: Lead arseniate = $3Pb_3As_2O_8$, PbCl. In this mineral the phosphoric is replaced by arsenic acid. Of a brown colour, and in much-curved or barrel-shaped hexagonal prisms. With pyromorphite at Sugar-loaf Hill, Wellington.

Wulfenite.

Chem. comp.: Lead molybdate = $PbMO_4$. Lead oxide, 61·5; molybdic acid, 38·5 = 100. Mentioned as occurring on a spur of Mount Murulla, Kingdon's Ponds, and near Mount Wingen. Structure, radiate and waterworn. The Rev. W. B. Clarke also records finding drifted molybdate of lead, on the North Shore.

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Galena.

Chem. comp.: Lead sulphide = PbS. Lead, 86·6; sulphur, 13·4 = 100. This, as elsewhere, is the commonest ore of lead; it not only occurs in large deposits, but it is widely distributed over the Colony.

It is usually found in the massive state, and with a granular structure which varies from fine to coarse. Occasionally it is met with fairly well crystallized, as at Cambalong, but on the whole crystals are rare. In other respects it presents all the usual properties of the mineral as found in other countries.

Localities—Near Inverell, and other places in New England; at Talwal Creek, on Yalwal Water; Reedy Creek; Wallabadah; on the Peel; the Page, Isis, and Hunter Rivers; at Burrowa, in quartz veins; with copper ores, on Lawson's Creek, a tributary of the Cudgegong; at Gulgong; Jugiong Creek; Crookwell River; Waroo, near Humewood; near Bathurst; Wellington; Sandy Swamp; at Mylora Creek, near Yass, in a quartz porphyry; at Woolgarloo, in association with fluor spar; near Bombala; at Kiandra, in quartz veins.

In all cases the galena is more or less rich in silver.

Tin.

Cassiterite.

Tinstone. Chem. comp: Tin binoxide = SnO_2. Tin, 78·67; oxygen, 21·33 = 100.

Tetragonal system. Occurs massive, crystallized, and as rolled pebbles and masses known as "stream tin." Well-developed crystals are by no means rare; the forms assumed are very similar to those found in other countries, viz., the prism, or a series of prisms combined with the pyramid, or pyramids, with and without the basal pinacoid plane. Sometimes the crystals are very large, especially those which are made up solely of the planes of the pyramid.

The lustre is usually bright metallic, hence many of the specimens are exceedingly pretty and brilliant, especially some of the ruby and amber coloured transparent specimens, which, however, have not as a rule so high a lustre as the black crystals; the colour varies from almost colourless and transparent, through shades of grey, yellow, amber, red, brown, to black, and opaque. Often more than one of these colours are to be seen in the same specimen, when the effect is very fine, especially the admixture of the ruby-red and translucent amber colours.

The hardness and sp. gr. do not appear to differ from tinstone obtained elsewhere.

The principal tin veins in New South Wales which have yet been worked, occur in granite at once seen to be similar to

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that of Cornwall. In some parts, as at Elsmore and Newstead, New England, much of it occurs in veins of greisen (mica and quartz), and in eurite (felspar and quartz). At Newstead Mine, and also at the Albion Tin Mine, crystals of tin-stone are seen disseminated through large and well-formed transparent quartz crystals. At the former place the quartz crystals in which it occurs often weigh nearly a hundred weight.

It occurs in association with molybdenite, fluor spar, a yellow steatitic mineral, garnet, beryl, topaz, the matrix of the tin-stone is sometimes in places composed solely of topaz; malachite, copper and iron pyrites, mispickle, tourmaline or schorl, in radiated groups of crystals, and wolfram. I have not seen wolfram in the same veins, but in other veins in almost juxtaposition.

Wood tin occurs in veins at Glen Creek.

Alluvial tin deposits.—There are two distinct sets of tin drifts, an older and newer; the former commonly occur at a lower depth, they are generally much more compact and often cemented together into a hard conglomerate, usually so hard as to require stamping. The tinstone is also much rounded and waterworn; whereas the tinstone in the newer drift is bright, and has undergone but little attrition. Some of the fragments or pebbles of rolled tinstone weigh many pounds, notably on the Butchart Tin Mine.

The minerals found associated with the stream tin are much the same as those found with it *in situ*; but in addition we find gold in small quantities, diamonds, the sapphire, zircon, pleonaste, topaz often of large size, bismuthite, rutile, and others.

Up to the present, most of the tin has been obtained from the New England district.

Rolled *wood tin* of a grey and black colour, at Abingdon; also at Grenfell, with extremely well-marked concentric and radiate structure, composed of red, brown, and black bands, other fragments made up of alternate light and dark-grey bands. Also Lambing Flat and Grampian Hills.

Localities.—The Undercliff and Bookookoorara, in county Buller; Tea-tree Creek, tributary of Orara River; Mitchell and Henry Rivers (County of Gresham); Gordon's Creek, Glen Creek, Ranger's Valley, Shannon River, Severn River, Paradise Creek, Sheep-station Creek, Spring Creek, Stockyard Creek; Swan Creek, near Inverell; Yarrow River, Middle Creek, Auburn Vale Creek, Cope's Creek, Sandy and Moredun Creeks, tributaries of the Bundarra, Kentucky Ponds, Honey's Creek, Honeysuckle Creek, Gwydir and Rocky Rivers, Sandy Creek, Warialda Creek, Myall and Reedy Creeks; Bald Rock; Nangahra, Tiabundie, and Mount Lowry Creeks; Maryland and Herding Creeks; Boonoo Boonoo; Mount Mitchell and Oban, Sara and Ann Rivers, Uralla, Carlyle Creek, Deepwater, Mole River, and Sandy Mount; Bende-

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meer in greisen; Quirindi, and Carroll's Creeks; Turon River, Shoalhaven River; Long Gully and Spring Creek, near Bungonia; Burra Creek, County of Selwyn; Dabarra, Jingellie Creek; at Mowemban in quartz associated with chalcedony. Vein tin occurs in quarries at Billabong, near Wagga Wagga. Rolled wood tin, with the diamonds near Mudgee and Bathurst; Tumberumba, with gold.

The first public mention made of the occurrence of tin in New South Wales was by the Rev. W. B. Clarke. In the *Sydney Morning Herald*, August 16th, 1849, he records having found it in the Alps along part of the Murrumbidgee.

Mr. Clarke mentions having found tinstone pseudomorphous after felspar crystals in New England.

In the *Papers relating to Geological Surveys* published by the Government, I find that Mr. Hargraves makes the following mention of tin ore in New South Wales:—

P. 71. "Guntawang, 18th July, 1851.

"I have received information from Mr. Rouse of this place (Guntawang) that a shepherd of his found tin at Warrambungall Mountain some years ago, distant 100 miles north of this place. I have therefore determined to visit the locality, and start for that place to-morrow, &c.

"E. H. HARGRAVES."

P. 72. "Mudgee, 3rd August, 1851.

"In travelling 6 miles N.W. of the Cudgegong, I found the gold region ceased; and on arriving at the Warrambungall Mountains, 100 miles N.W., I found coal and iron in great abundance on every hill, but was not successful in finding the tin. The shepherd who knows the locality gave me a piece which he had smelted into bars, a sample of which I herewith enclose, which I should suppose contains 30 per cent. of silver, and in a short time the locality will be known to me. The man wants a large consideration for disclosing the whereabouts at present.

"E. H. HARGRAVES."

Amount of tin ore raised from 1872 up to the end of 1874 was valued at £866,461.

Titanium.

RUTILE.

Chemical composition: Titanic acid = TiO_2. Crystallizing usually in tetragonal prisms. Up to the present time I have only found it in the form of fragments of crystals with striated surfaces, or in rounded grains of a hair-brown colour. It is found with the gem sand from Bald Hill near Bathurst and at Uralla.

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Brookite.—Which is an allotropic form of titanic acid, crystallizing in flattened forms belonging to the rhombic system, has also been found in New South Wales.

In the diamond drift near Mudgee as flat, transparent, red and translucent reddish-white plates, with striated surfaces. H = 6, and sp. gr. = 4·13. Chem. comp.: Pure titanic acid, except a minute trace of iron oxide (Dr. Thomson).

Anatase.—A third allotropic form of titanic acid, crystallizing in tetragonal pyramids. This has been found at the dry diggings of Burrandong.

Sphene.

A calcium silico-titanate. Locality is uncertain; I have met with but one well crystallized specimen, of a green colour.

Tungsten.

Wolfram.

Iron and manganese tungstate = $(FeMn)WO_4$. It is found in rolled masses in association with tin-stone in many parts of New England. It is also found *in situ* in the quartz veins on Elsmore, Newstead, and other places, in the usual form of imperfectly developed tabular crystals. It is commonly accompanied by iron pyrites.

Scheelite.

Calcium tungstate = $CaTiO_3$. Probably occurs in New England.

Molybdenum.

Molybdenite.

Chemical comp.: Molybdenum sulphide MoS_2.

Usually found massive with a coarsely granular structure; also in grains, scales, plates, and rosette clusters of crystals. Sometimes the flat hexagonal plates or crystals are of large size; I have found some as large as a half-crown on the Elsmore Tin Mine.

The colour is usually bluish-white, with a strong metallic lustre.

Associations.—It is rather common in the New England tin districts, especially at the Elsmore and Newstead tin mines, where it occurs in the tin veins traversing the granite. It is most usually associated with quartz. On the Hunter River it is found associated with gold, galena, pyrites, and other minerals.

Localities.—It also occurs at Bullin Flat, near Goulburn, at Kiandra with quartz, and Cleveland Bay.

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Arsenic.

Native Arsenic.

In massive pieces with mammillated surface, Lunatic Reef, Solferino.

Mispickle.—Arsenical Pyrites.

Chem. Comp.: Sulp-arsenide of iron FeS + FeAs.

Arsenic, 46·0; sulphur, 19·6; iron, 34·4 = 100. Rhombic system. Colour almost silver white. Streak dark-greyish black.

Rather large crystals occur with quartz near Goulburn, also Shoalhaven River associated with small hexagonal prisms of beryl, which penetrate the mispickle. In New England, Elsmore, and other places. Near Orange, very rich in gold. On the Moama or Mitchell River near Cooradooral.

At Carcoar, with marcasite and common pyrites. Gulgong.

Occasionally the mispickle is exceedingly rich in gold.

Tellurium.

Native Tellurium.

A rare metal—reported to occur at Bingera.

Antimony.

Native Antimony.

I can find no authentic record of the occurrence of native metallic antimony in New South Wales, although I believe it has been met with in New England and elsewhere.

Antimonite.

Chem. Comp.: antimony sulphide = Sb_2S_3.

Sb = 71·8; S = 28·2 = 100.

This ore is met with in the massive state in mineral veins, and occasionally in rolled masses; crystals appear to be rare.

It occurs on the Clarence and Paterson Rivers, the mineral occuring in masses of large size, and showing broad, well-defined, striated cleavage planes, portions of the surface usually being incrusted with a yellow coating of cervantite, an oxide of antimony = $Sb0_4$.

It is found associated in many parts of New England with tinstone, molybdenite, wolfram, and other minerals.

Localities.—Tenterfield, Armidale, Gresford, Rylstone, Rocky River, Grafton, Macleay and Hastings Rivers, near Mt. Mitchell, Boorolong, Gara, Drake, Nundle Gold Field, Solferino, Wallerawang, Gundagai, Shoalhaven River, Eden, Twofold Bay.

The Rev. W. B. Clarke records finding a rolled mass on the North Shore.

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Cervantite.

Chem. Comp.: Antimony oxide = SbO_4. Sb = 79·2; O = 20·8 = 100.

Usually occurs massive, as an incrustation upon antimonite sometimes as minute circular crystals of a dull yellow colour.

Localities.—Almost the same as those for antimonite, as at Gwyra near Armidale, Pyramul, and other places.

Jamesonite.

Chem. Comp. = 2 (PbFe) S + $Sb_2 S_3$.

Sulphur, 21·1; antimony, 32·2; lead, 43·7; iron 30 = 100.

This mineraly usually occurs in fibrous masses of a bluish lead-grey colour.

It occurs with cervantite in a soft quartz near to Campbell Creek and Nuggety Gully, Bathurst district.

Bismuth.

Native Bismuth.

Found in the New England District between Oban and Tenterfield. This metal is now becoming very valuable.

Bismuthite.

Chem. Comp.: A hydrated carbonate of bismuth. Bismuth oxide, 90·0; carbonic acid, 6·5; water, 3·5 = 100.

Found in the form of more or less rounded grains and pebbles with stream tin in the New England district.

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PART II.

NON-METALLIC MINERALS.

CLASS I.

Carbon and Carbonaceous Minerals.

DIAMOND.

Chem. comp.: Carbon. Cubical system. The first mention made of the existence of the diamond in New South Wales, which I have been able to find, is one by Mr. E. H. Hargraves, who, in his report, dated from the "Wellington Inn," Guyong, on the 2nd July, 1851, refers to some enclosed specimens of gold, gems, and "a small one of the diamond kind," from Reedy Creek, 16 miles from Bathurst. The next record of the occurrence of the diamond in New South Wales appears to have been made by the Rev. W. B. Clarke, in an appendix to his "Southern Gold Fields," published in 1860; he records that four were brought to him on September 21st, 1859, which were obtained from the Macquarie River, near Suttor's Bar; the crystalline form which they exhibited was that of the triakisoctohedron or three-faced octohedron, and one of them had a sp. gr. of 3·40. Another which was received from Burrendong, on December 29th, 1859, had a sp. gr. of 3·50. One from Pyramul Creek, crystallized in the hexakis or six-faced octohedron, weighed 9·44 grains, and had a sp. gr. of 3·49. Another was sent to him in August, 1860, which had been found in the Calabash Creek by a digger as far back as 1852.

Diamonds were found by the gold diggers on the Mudgee Diamond Diggings in 1867, but were not especially worked until 1869.

The diamonds were obtained from outliers of an old river-drift which had in parts been protected from denudation by a capping of hard compact basalt. This drift was made up mostly of boulders and pebbles of quartz, jasper, agate, quartzite, flinty slate, silicified wood, shale, sandstone, and abundance of coarse sand mixed with more or less clay.

Many of the boulders are remarkable for the peculiar brilliant polish which they possess. The principal minerals found with the diamond are gold, garnets, woodtin, brookite, magnetite, ilmenite, tourmaline, zircon, sapphire, ruby, adamantine spar, barklyite, common, and a peculiar lavender-coloured variety of corundum,

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quartz, topaz, magnesite and nodules of limonite which had been set free from an impure magnesite, black vesicular pleonaste, spinel, ruby, and osmo-iridium.

The largest diamond found weighed 16·2 grains, or about $5\frac{5}{8}$ carats.

The average sp. gr. was 3·44, and the average weight of a large number of those obtained was but 0·23 carat. (For further particulars, see paper on the Mudgee Diamond Fields, by Professor Thomson and Mr. Norman Taylor, in the Trans. Roy. Soc. N.S.W., 1870.) The total number found has been stated roughly at about 6,000; the number also from Bingera must be nearly as many—in all, say, 10,000 at least.

In colour they vary from colourless and transparent to various shades of straw, yellow, brown, light-green, and black. One of a rich dark-green was found in the form of a flattened hemitrope octohedron.

The most common crystalline forms which have been met with are the octohedron the hemitrope octohedron, the rhombic dodecahedron, the triakis and hexakis octohedron. The flattened triangular hemitrope crystals are very common; one specimen of the deltoidal dodecahedron was met with.

The lustre is usually brilliant or adamantine, but occasionally they have a dull appearance. This is not due to any coating of foreign matter or to the same cause as the dulness of less hard waterworn crystals; but it is owing to the presence of innumerable edges and angles belonging to the structure of the crystal; these reflect the light irregularly at all angles and give the stone its frosted appearance.

The diamonds at Bingera occur under almost exactly the same circumstances as at Mudgee, and with the same minerals, except that I did not come across either the black vesicular pleonaste or barklyite.

From a series of determinations made on nineteen of the Bingera diamonds, I obtained a mean sp. gr. of 3·42. (For details *vide* paper upon the Bingera Diamond Fields—Trans. Roy. Soc., N.S.W., 1873.)

Diamonds have also been found at Bald Hill, Hill End, with the same gems as at the above-mentioned places; one octohedral crystal, rather flattened, which I examined, weighed 9·6 grains (troy) and had a sp. gr. of 3·58.

A specimen of "bort" or black diamond was presented to me by Mr. J. R. Peebles, of Sydney, which was obtained near Bathurst; it is of about the same size as a large pea, black in colour, with a graphitic or black-lead lustre; it is very nearly spherical in form, but has a few slight irregular processes, which seem to be due to an attempt to assume the form of the hexakis octohedron.

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In weight it is 7·352 grains (troy), and at 70° F. the sp. gr. is 3·56.

Mr. Wilkinson mentions, that from the Bengonover Tin Mine, near the Borah Tin Mine, several diamonds were obtained, the largest being 7·5 grains. From the Borah Tin Mine, situated at the junction of Cope's Creek with the Gwydir, 200 were obtained in a few months; out of a batch of 86, averaging 1 carat grain each, the largest weighed 5·5 grains. Diamonds have been found on most of the alluvial tin workings at Cope's, Newstead, Vegetable, and Middle Creeks, and elsewhere in the district.

Amongst other places the diamond has been found in the Turon, the Abercrombie, the Cudgegong, Macquarie, and Shoalhaven Rivers. One was found in August, 1874, in Brook's Creek, Gundaroo, near Goulburn, valued at £3. At Uralla, Oberon, and Trunkey, they are by no means uncommon; and I have recently obtained a small hemitrope octohedron from the Lachlan River weighing 1·5 grains.

Diamonds have also been obtained from diggings on the seashore near to Ballina.

A drift having almost exactly the same characters as those at Bingera and Mudgee, occurs at Wallerawang, and on the Mary River, Queensland—even to the presence of masses of conglomerate of jasper, quartz, and other pebbles agglutinated together by a ferruginous and manganiferous cement.

Graphite.—Plumbago.

Chem. comp.: Carbon. Hexagonal system. Occurs with quartz, iron pyrites, and pyromorphite at the head of the Abercrombie River, possesses a curved lamellar structure. Occurs in small radiating masses in the granite at Dundee, in New Valley, and near Tenterfield.

Reported also from Bungonia, but its existence there is doubtful; also from the Cordeaux River, near Mt. Keira, and Plumbago Creek near junction of Timbarra Creek, county of Drake.

Small particles are not uncommon in the sandstone about Sydney and other parts.

Any black clay or other substance which can be made to leave a mark on paper is brought into Sydney as a sample of a most valuable deposit of graphite. I have not yet seen, out of many highly extolled specimens, one fit for even the commonest purpose.

Coal.

As a mineral there is not much to be said about the coal of New South Wales, as there is no very material difference between it and that of England. The coal from certain mines is caking, and from others non-caking, *i.e.*, it will not furnish a coke. The

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amount of ash varies considerably, the coal from some of the Northern pits not containing more than about 2·0 per cent., while some of the Western and Southern coals contain from 8 to 14 per cent. In some cases the seams are from 30 to even 40 feet in thickness.

Localities.—Owing to coal being widely distributed over New South Wales it would be almost an endless task to mention the names of places under which it lies or at which it crops out, it must therefore suffice to refer the reader to the mineral map published by the Government.

The area of the various coal fields of New South Wales is approximately estimated at some 24,840 square miles.

The amount of coal raised during the year 1874 was in round numbers :—

Northern Gold Fields	1,126,000	
Southern do.	137,000	
Western do.	44,000	
Total	1,305,000	tons.

Valued at about £975,000.

For analyses of the coal raised by the various pits in New South Wales, I must refer you to my report made to the Mining Department, and now in course of publication by the Government; but there are one or two other analyses which are not included in that paper; the following is by Mr. Rich. Smith of the School of Mines, London :—

Bulli Coal.

Carbon	75·57
Hydrogen...	4·70
Oxygen and Hydrogen	4·99
Sulphur	0·54
Ash	13·17
Water	1·03
	100·00
Coke	74·78
Volatile gaseous matter	24·19
Water	1·03
	100·00

Sp. gravity = 1·471.

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Some analyses of the Wallerawang Coal gave the following results :—

A sample from a seam 17 feet 6 inches thick gave :—

Moisture	1·51	
Volatile hydrocarbons ...	33·24	
Fixed carbon.....	55·74	} Coke = 65·24 per cent.
Ash, white.....	9·50	}
	99·99	

Sp. gravity = 1·333.

Another seam 6 feet 6 inches thick :—

Moisture	1·95	
Volatile hydrocarbons ...	27·25	
Fixed carbon.....	61·86	} 70·80 per cent. coke.
Ash, white.....	8·94	}
	100·00	

Sp. gr. = 1·398.

The coal from the Waratah Company's mine is sometimes beautifully iridescent. And in the Australian Agricultural Company's Borehole pit, nodules of hard and compact anthracitic coal are met with in the substance of the softer coal.

Coal containing pea-iron ore is abundant at Nattai. Another coal, from near to Nattai, is very brilliant in lustre, and breaks with a pitchy lustrous conchoidal fracture like albertite; it is also marked by the presence of thick layers of "mother-of-coal" or fibrous mineral charcoal.

A splintery anthracite is said to occur at Gordon Brook, in the county of Richmond. As far as I have seen at present, only one of the so-called New South Wales anthracites are really deserving of that name, the others are merely very poor or else baked coals, *i.e.*, coal which has been more or less destroyed by the intrusion of a dyke of some igneous rock.

LIGNITE.—Brown coal.

Chem. comp.: Carbon, hydrogen, oxygen, and ash. This substance may be looked upon as an imperfect coal. In some cases it still retains the original fibrous woody structure; in other cases it is scaly or massive.

Found at Kiandra. Brown, but black in parts, with a pitchy lustre; fracture subconchoidal; exhibits woody structure. On the Lachlan River, where it possesses a platy structure; found also on Mr. Berry's land, at the mouth of the Shoalhaven, at a depth of 12 feet; also at Turalla Creek, County of Argyle, retains original structure of the wood, and has much the same appearance as "bog oak."

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Resinite.

Reported to occur on the Clarence River.

Bog Butter.

A white, soft, somewhat unctuous substance, found between Twofold Bay and Brogo. Mentioned by the Rev. W. B. Clarke.

Mineral Wax.—Ozo-kerite.

Chem. comp.: Carbon, hydrogen, and oxygen. Of a brown-grey colour. Breaks with a subconchoidal fracture. Coola.

Bathvellite, or Torbanite.

Found at Mt. York and Macquarie Fields.

Elaterite.—Elastic bitumen.

Chem. comp.: Carbon, hydrogen, and oxygen. At Reedy Creek or Petrolia there is said to be a band of thin and very elastic substance like elaterite.

Kerosene Shale.

This mineral is found abundantly in the coal measures of New South Wales, usually in the form of more or less lenticular deposits. The name wollongongite was given to it by Dana, but the term has never come into general use.

In colour the mineral varies from brown, sometimes a greenish-brown, to jet black. It usually weathers white, and as the surfaces of the joints are also usually coated with a thin film of a white clay-like substance, the mineral is sometimes termed "*White Coal.*" The fracture is usually large conchoidal. When struck it gives out a woody sound. Can be cut by the knife into comparatively thin shavings. Gives a black shining streak and a brown powder. Thin sections, under the microscope, show an amber, brown, and black reticulated structure. The brown portions are those which transmit the light, and the black the opaque portions. Mr. E. T. Newton, assistant naturalist to the Geological Survey of England, has recently written a valuable and interesting paper upon the microscopic structure of the so-called white coal and tasmanite of Tasmania. (See Geol. Mag., Sept., 1875.)

Chemical Composition.

Different samples vary very much in composition. From analyses which I have made, the following results were obtained:—

	Greta.
Moisture	·48
Volatile hydrocarbons ...	61·66
Fixed carbon	25·13
Ash (grey)	13·21
	100·00

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Murrurundi.

	(1.)	(2.)
Moisture	1·00	1·01
Volatile hydrocarbons ...	66·33	71·70
Fixed carbon	6·27	6·17
Ash (grey)	26·40	21·12
	100·00	100·00

	Hartley.	*Wollongong.*
Moisture ... ... } Volatile hydrocarbons } ...	82·24	82·50
Fixed carbon	4·97	6·50
Ash...	12·79	11·00
	100·00	100·00

Specific gravity = 1·052.

From the Hartley specimen, the ash was pinkish grey.

The analysis of the specimen from Wollongong was made by Prof. Silliman.

A very similar shale is found in New Caledonia; the physical properties are very similar, and the chemical composition is shown by the following analysis:—

Moisture ... ... } Volatile hydrocarbons } ...	65·17
Fixed carbon	8·71
Ash	26·12
	100·00

Specific gravity = 1·238.

Some of the Hartley shale has been known to yield as much as 180 gallons of crude oil per ton.

Some specimens from Hartley give on fracture very long flexible concavo-convex flakes. Again, some shales like those from Murrurundi are full of little specks of a white aluminous pipeclay like mineral.

The kerosene shale when heated in a tube neither decrepitates nor fuses, but there distils over from it a mixture of gaseous and liquid hydrocarbons.

It is found at Stony Creek, Berrima, Wollongong, American Creek, near Murrurundi; Greta, Lake Macquarie, and Hartley.

Jet.

A true jet which takes a high polish and breaks with a conchoidal fracture, occurs as occasional layers in the Hartley shale.

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CLASS II.

Sulphur.

NATIVE SULPHUR.

Occurs in small quantities as a sublimate from the vents of Mount Wingen, the so called "Burning Mountain," in association with iron sulphate and various other salts.

CLASS III.

Salts.

COMMON SALT.

Chem. comp.: Sodium chloride. Common in most spring waters; occasionally found as an incrustation from the evaporation of lakes and waterholes.

NATRON.

Chem. comp.: Hydrated sodium carbonate. Said to occur as a deposit from the Mud Wells in the Namoi Scrub.

CLASS IV.

Earthy Minerals

BARYTES.—Heavy spar.

Chem. comp.: Barium sulphate. Rhombic system. It occurs with fibrous and massive green carbonate of copper, copper pyrites, and galena, at Cambalong, Merinoo.

SELENITE, or Gypsum.

Chem. comp.: Hydrated calcium sulphate. Rhombic system. Found crystallized in clay on the Darling River. Also on the Bogan River. Of commercial value for the manufacture of Plaster-of-Paris and other cements.

ARRAGONITE.

Chem. comp.: Calcium carbonate.

Rhombic system. Good crystals of this form of carbonate of lime are perhaps more common than of the former mineral calcite, especially in connection with stalactites and as enclosures within the amygdaloidal cavities of basalt.

Beautiful groups of crystals and bunches of *flos ferri* have been obtained from the limestone caves at Lob's Hole, the Coodradigbee, the junction of Cotton's River and the Murrumbidgee; and from near Bungonia. It also occurs at the Cataract River, and fair specimens of stalactitic arragmite are to be seen at Port Hacking. The more or less spherical concretions termed "cave pearls" by Professor Boyd Dawkins, F.R.S., are also found in some of the above caves notably from those at the Coodradigbee.

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Arragonite occurs in vesicular basalt at Cherry-tree Hill near Mudgee, and groups of radiating crystals several inches in length are met with in a similar rock at Inverell; Jordan's Hill, Cudgegong; at the Brick Kiln, Rock Flat, in radiate columns or crystals of variegated green and white colours.

Calcareous Tufa, or Fresh-water Limestone.—At Burragorang, Quialago Creek, Goulburn Plains, and at Newstead Station, New England.

CALCITE.—Iceland spar.

Chem. comp.: Calcium carbonate. Hexagonal system. Sometimes well-developed crystals are met with. The usual forms are rhombohedra and their combinations, also combined with the terminal pinacoid or O.P. plane, and occasionally scalenohedra. I have not as yet observed the prism amongst the New South Wales forms.

The localities for calcite are extremely numerous, as it is met with wherever limestone occurs, and is a common substance in mineral veins.

Large well-developed flat rhombohedral crystals of calcite occur, associated with quartz, in the joints and cavities which exist in the basalt of the Pennant Hills, near Parramatta. It is also met with in the quartz veins in association with and as the matrix of gold, as at Gulgong and other places. It is sometimes present in the joints in sandstone, as at the Cataract River.

Opaque white calcite occurs at Capertee.

Marble.—Several beds of very fine marble, or crystalline limestone, occur in different parts of the Colony, as at Wollondilly, whence one of the marbles, used in paving various public buildings in Sydney has been obtained—as the great hall at the University, and at the Post Office. Much of the Wollondilly so-called "white marble" is of a creamy tint, variegated with pale red and light blue streaks. A slate-coloured marble, used in the same buildings, is brought from Marulan, near Goulburn. There is a beautiful white marble near Bathurst, and a brecciated slate-coloured one streaked with white at Wallerawang and other spots between the above two places. Beautiful marbles occur at Mudgee and Orange; also at Wellington, celebrated for its caves. At Bangalore, on the Goulburn Plains, there is found a white crystalline marble. At Yass. Queanbeyan. Good grey and white crystalline marbles are found along the banks of the Murrumbidgee. There are many caves in the limestone between the Belubula River and the Conomodine Creek, in the Orange district, containing animal remains, some of which are of considerable size. Blue-grey limestone at Warialda. The outcrops of small seams of grey crystalline limestone or marble are seen exposed in the Minumurra Creek, near Jamberoo, interbedded with the coal, shale, and sandstones of that district.

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Oolitic Limestone.—A limestone of this structure is said to occur on the Page River.

Concretions.—Calcareous concretions are common in the black and chocolate coloured soils of igneous origin, which occur in various parts of the Colony, such as on the Liverpool Plains, New England, Gwydir district, Hunter River district, and at Scone, and in numerous other localities where there is a soil derived from the decomposition of a basaltic or other igneous rock.

Strontianite.

I have not yet met with any strontium minerals in New South Wales.

Apatite.

Chem. Comp.: Chloro-phosphate of calcium. Crystallizes in the hexagonal system, in the form of six-sided prisms. It is reported to occur in well-formed crystals with bitter spar on the Lachlan, between Boco Rock and Wog-wog, and with graphite and quartz at the head of the Abercrombie River; also on the Clarence River.

This mineral is of considerable commercial value.

Wavellite.

Chem. Comp.: A hydrated aluminium phosphate. A yellow mineral, reported to be Wavellite with a radiate structure is found in the fissures of felstone pebbles common in Rat's Castle Creek, Two-mile Flat, Mudgee.

Fluor Spar.

Chem. Comp.: Calcium fluoride. Crystallizes in the cubical system.

Up to the present it has apparently only been found in the massive state, or in but very imperfect octohedral crystals. This mineral has been met with in several places in the New England district, near to Inverell, at Elsmore; at the Boundary, Sydney and Caledonian Tin Mines, on Cope's and Middle Creeks, where it is found in association with tinstone, a green steatitic clay, copper pyrites, galena, quartz, molybdenite, and other minerals, all of which may often be seen in one hard specimen.

It also occurs at south Wiseman's Creek in association with copper ores; in certain cases the fluor is much fissured, and the cracks are filled in with red oxide and blue carbonate of copper, which impart to the mineral a very pretty and ornamental appearance, and it would in consequence probably serve for inlaid work. At Woolgarloo Lead Mines it is found in the massive state as the matrix of galena; it is usually opaque or but semi-translucent white with pale-bluish or purple veinings.

At Mount Lambie Mr. Wilkinson reports its presence in the Devonian beds.

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Epsomite.

Chem. Comp.: Hydrated magnesium sulphate. Occurs as an efflorescence in the caves of the Hawksbury sandstone; usually masses of fibrous crystals are met with sometimes five or six inches in length, of a beautiful white silky lustre. The crystals are usually curved towards the free end; also in radiate groups of small crystals. Very fine specimens have been obtained from Dabee, Wallerawang, and Mudgee, the Great Western mines, Icely, and Barragorang.

Magnesite.

Chem. Comp.: Magnesium carbonate. Crystallizes in the hexagonal system, usually as rhombohedra; but no well-developed crystals have yet come under my notice. It is most commonly found massive, or in concretions, having a mammillated or botryoidal form. H. = 4 to 5. Sp. gr. = 2·94.

It is found in New England in various places, and upon the Diamond Fields at Bingera, and near Mudgee; when impure it is of a gray or gray-brown colour, but when pure it is of a dazzling white; compact, tough, and breaks with a flat conchoidal fracture. It adheres to the tongue, and has a very cold feel like porcelain.

It effervesces with hydrochloric acid, but with difficulty.

At the diamond diggings at Two-mile Flat, near Mudgee, pure white magnesite was observed to form by the spontaneous decomposition of the heaps of refuse from the miners' shafts; pebbles were quickly cemented together by it.

The late Dr. Thomson of the Sydney University found that the magnesite thus formed, and incrusting rubbish heaps, timber, old tools, etc., had the following composition:—

Magnesia	46·99
Carbonic acid	49·78
Water	4·08
	100·85

Sp. gr. = 2·94.

This magnesite sometimes contained calcite. It was also observed under the same circumstances on Cunningham's Diggings on the east side of Cudgegong Creek, and there with a peculiar vermicular or worm-like form.

Another locality is the Lachlan River.

Sulphate of Alumina.

Chem. comp.: Hydrated aluminium sulphate. Commonly called "alum," from its astringent taste, but potassium is absent from the mineral.

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Commonly met with as an efflorescence in caves and under sheltered ledges of the coal measure sandstone, as at Dabee, Wallerawang, Mudgee Road, the mouth of the Shoalhaven River, and other places where it is usually associated with epsomite. Also found in the crevices of a blue slate at Alum Creek, and at the Gibraltar Rock, Shoalhaven. Occurs as a deposit with various other salts from the vents at Mount Wingen, together with native sulphur in small quantities.

WEBSTERITE.

Chem. Comp.: Aluminium sulphate. Reported to occur on Brush Creek, Dumaresq River.

Silica.

QUARTZ.—Rock crystal.

Chem. comp.: Silica. Hexagonal system. Found in nearly all parts of the Colony, and in crystals more or less perfectly developed; the most common form is the prism combined with the pyramid. Occasionally prisms closed at both ends by planes of the pyramid; also double pyramids. Such crystals are, however, usually small and generally occur in quartz porphyries, or are derived from the decomposition of such.

Occasionally some very large crystals are met with, notably at Newstead Tin Mine, New England, where, in one of the shafts, crystals nearly one cwt. were met with; within these, crystals of tinstone were often found disseminated.

Large crystals of smoky quartz are common almost throughout New England, as at Bingera, Inverell, Cope's Creek, Uralla, and at Mudgee. Some of the rock crystals found in the alluvial tin deposits present a very pretty appearance, from the presence of numerous minute fissures and internal films, streaks and patches of yellow, orange, and red colours. Most of the crystals from New England have one face of the pyramid much more largely developed, so much so in some cases as to almost obliterate the others.

Elongated pyramids containing disseminated crystal of cassiterite are common at the Albion Tin Mine; these crystals of quartz are dull and slightly rough on three of the faces, and bright on the opposite three.

Smoky brown Cairngorum and limpid quartz crystals are plentiful in Ranger's Valley, River Severn; Macintyre River, Middle Creek, Byron's Plains.

Quartz crystals with rounded edges and dull surfaces, as if acted upon by hydrofluoric acid, occur in the coarse-grained granite on Mann's River.

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Quartz crystals are common near the junction of the Turon and Macquarie Rivers; at Bukulla, clear and brilliant crystals; from the Diamond Mountain, Cudgegong, Macquarie River, in anamygdaloidal basalt, Deep Lead, Gulgong Rush; at Carcoar, containing lamellar magnetite, also with a pale blue quartz. Well-developed and brilliant crystals from Bullamalite Creek, a tributary of the Mulwaree, near Goulburn, at Gurragangamore and other places on the Goulburn Plains; the Lachlan River, Cooma, Kiandra, the Murrumbidgee; in the Naas Valley, with tourmaline and schorl; between Pambula and Eden, with molybdenite.

Up to the present the number of substances which I have observed enclosed within quartz crystals found in this Colony is not great.

Endomorphs in Quartz Crystals.

1. Actinolite—Morvembah, Morendee, on the Meroo, a tributary of the Cudgegong.
2. Asbestos—Uralla.
3. Cassiterite or Tin-stone—Albion and Newstead Mines, New England.
4. Epidote—Towamba and Maneero.
5. Argentiferous Galena—Near Summer's Hill, Bathurst.
6. Gold—Boro Creek and other places.
7. Graphite—Head of Abercrombie River.
8. Orthoclose felspar—Two-Mile Flat, Mudgee.
9. Molybdenite—Bullio Flat, near Goulburn.
10. Rutile.
11. Schorl and tourmaline—Murrumbidgee.

Pseudomorphs.

That is, quartz possessing the external form of other minerals. Quartz after calcite—Gulgong, Yass, and Bathurst; also, often iron pyrites and mispickle.

Amethyst.—A pale purple-coloured variety of quartz. It occurs as geodes in the basalt at Kiama; the crystals are usually small, not being more than $\frac{3}{8}$ of an inch through. Found also at Dubbo. A quartz vein containing amethystine quartz occurs near the top of Bullabalakit.

Agate.—Agates consist of mixtures of crystalline quartz and chalcedony, usually arranged in concentric layers and bands; their structure is caused by the peculiar mode of formation, viz., by the infiltration of silica into the amygdaloidal cavities of igneous rocks.

They are common in the basalt at Kiama, near Scone, Inverell, and other places, and are very plentiful in the beds of many of the rivers and old drifts of New South Wales, as in the Mackintyre, parts of the Gwydir, the Hunter, the Cookaboo, where they are derived from the basalt of the Western Range or Dewingbong Mountain.

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Agates and chalcedony are plentiful near Dubbo and Bald Hill, Wellington, Mount Wingen, Maitland, Cowriga, and other places.

Jasper.—Is very abundant and widely distributed throughout various parts of New South Wales. It is found of nearly all shades of colour—pure white, grey, slate, dull blue, olive and bright greens, brown, red, and black, both alone as simple colours, and in varied combinations of stripes, streaks, and bands and mottlings.

It is found mainly in the form of boulders and pebbles in river beds, and it enters largely into the composition of nearly all conglomerates, gravelly alluvial deposits, and river drifts.

The peculiar variety known as Egyptian jasper does not appear to have yet been met with.

Amongst the principal localities are the Gwydir, the Mackintyre, the Macquarie, Cudgegong, the Hunter, the Murrumbidgee, and many of their tributaries. There are large quantities of fine red jasper near Gobolion; also near Scone. The drifts at Mudgee, Bathurst, Bingera, Lake George, Molong, and other places are rich in fine jasper specimens.

Ribbon Jasper.—At the junction of Pink's Creek with the Bell River a clay slate has been converted into ribbon jasper.

Eisenkiesel.—A variety of ferruginous quartz. Large masses of this mineral *in situ* occur near Bingera; it also abounds between Guano Hill and the Bell River, at Carcoar, Mount Lindesay, and at the junction of Cotter's River with the Murrumbidgee.

Lydian Stone.—A velvet black form of jasper, used by jewellers as a touchstone for gold alloys. Mullion Range, Bathurst country.

Chert.—Common in seams and bands throughout the coal measures. Its structure is often more or less lamellar, and the fracture conchoidal. Mount Victoria, Wallerawang, Hartley, Jamberoo, Illawarra, Lachlan River.

Chalcedony.—An amorphous or crypto-crystalline form of quartz. There are several varieties of chalcedony.

Chalcedony proper: Massive, translucent, pale-grey, blue, or brown; with waxy lustre; surface mammillated, and often of a stalactitic form.

Nodules of chalcedony are found near Carcoar, with resinite and chert; also at Cowriga Creek, Wellington, Dubbo, Maitland, the Hunter River, and filling lines of small cavities in a green felstone on Rat's Castle Creek, 6 miles S.E. of Two-mile Flat.

Carnelian: Is a bright red chalcedony, but the ornamental white varieties of chalcedony are also usually included under the same name by jewellers.

Red and white carnelians are rather common in the Hunter River, or Maitland, and other places; also near Wellington; in Pond Creek, near Inverell.

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Opal.

This mineral consists of silica, with usually from 5 to 12 per cent. in water.

Precious or *Noble Opal:* The precious opal of New South Wales has the milky body colour usually possessed by this mineral, and the same brilliant play of colours; the dominant colours of the scintillations are metallic green, pink, and red. Some of the best specimens form, when polished, very fine gem-stones; but here as elsewhere the valuable specimens obtained bear but a small proportion to the whole. The best have been obtained from Rocky Bridge Creek, Abercrombie River; the matrix is a fine-grained bluish-grey amygdaloidal trachyte, which is so much altered that it can be abraded by the thumb-nail; the opal has filled by infiltration certain of the vesicular cavities and crevices in this rock; it is associated with much common opal free from any play of colour.

The appearance and mode of occurrence of the opal found at Bulla Creek, in Queensland, is very different; the body colour of the Queensland opal is usually deep ultramarine blue or green, and the reflections are usually metallic green and red; the matrix is in this case a brown mottled clay porphyry, in which the opal occurs as small veins and strings.

Opal is also found in a similar clay porphyry in the Wellington District; but up to the present I have only seen very small particles of the precious opal diffused through much valueless opal; also occurs at Bland, near Forbes; also at Coroo, with chalcedony, agates, &c.; and at Bloomfield, near Orange.

Fire Opal or Girasol—(*i.e.*) An opal with a red or orange tint—occurs at Wellington. But little valued.

Common Opal, Semi-Opal, and Wood Opal: Are common in all the basaltic districts; Uralla, Inverell, Richmond River, Trunkey, Scone; Hunter, and Castlereagh Rivers, Kiama, Lachlan River.

Cacholong: Dead white; conchoidal fracture; adheres to tongue. Tumut.

Hyalite: Muller's Glass.

Found coating the joints in basalt, Jordan's Hill, Cudgegong; of a blue colour at Ororal.

Silicified Wood.—Is very abundant over nearly all the basaltic districts; the two have always been observed in close proximity. It is very abundant also throughout the coal measures. Large boulders of such fossilized wood are met with in most of the drifts and river deposits.

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Hornblende Group.

HORNBLENDE.—Amphibole.

Chem. comp.: Silica, magnesia, lime, iron, manganese, &c. Oblique system. Different varieties of hornblende vary extremely in colour, form, and composition:—

1. *Tremolite.*—A white or nearly white variety occurs, at Cooma, in long slender crystals.

2. *Actinolite.*—A dark-green fibrous actinolite occurs at Mowembah in quartz.

3. *Sahlite.*—Crystals of this form occur in a compact augite paste on the Cowriga Rivulet.

Large crystals of common hornblende occur at Uralla, Tenterfield, and in New England district, and in other places. In quartz with lamellar magnetite, at Merrendee, on the Meroo, a tributary of the Cudgegong; and on the road from Jungemonia to Uranbeen; also at Cooma.

ASBESTOS.—Amianthus.

Chem. comp.: Magnesium silicate.

A fibrous variety of hornblende.

Said to occur in veins at Bukulla, at Guyong, and Berrada Creek, Wellington. In basalt at the Pennant Hills, near Sydney. With auriferous quarts in diorite at Gulgong; also found at Wentworth, Lucknow Gold Field, Icely; Lewis Ponds Creek, Lachlan River.

PECTOLITE?

Chem. comp.: Aluminium calcium and magnesium silicate. A light-grey and white fibrous mineral, very tough; found at Mount Walker by Mr. Wilkinson, containing casts of *spirifers*. The rock has at the spot where this mineral occurs, been metamorphosed by the intrusion of a vein of igneous rock.

CHLORITE.—Green earth.

Chem. comp.: Hydrous silicate of alumnia and magnesia, with more or less oxide of iron.

In a confused mass of various crystallized substances, Gulgong, Lachlan River.

De Leesite.—A ferruginous chlorite. Its occurrence is mentioned by the Rev. W. B. Clarke.

Serpentine Group.

There are several varieties of the mineral serpentine met with in New South Wales. The rock of the same name is also found very largely developed, both in the Northern, Western, and Southern districts.

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Serpentine.

Chem. comp.: Hydrous silicate of magnesia.

Of an oil-green colour, semi-transparent, on the Murrumbidgee; at Bingera, Warialda, Barraba, and Stony Batta.

Williamsite.—Apple-green, translucent, somewhat greasy to the touch, takes a very fair polish, and forms very pleasing ornamental stone. H. = 3.

From Tuena.

Marmolite.—A foliated variety of serpentine, occurs on the Murrumbidgee, of a yellowish colour, associated with dull-red and green serpentine rock.

The late Mr. Stutchbury mentions the occurrence of an orbicular serpentine on the Apsley, Manning, and Hastings Rivers or Creeks.

Picrolite.—Chem. comp.: Hydrous magnesium silicate.

A fibrous variety of serpentine. Found at Kelly's Creek, Gwydir River, and in the serpentine at Bingera, with meerschaum. It occurs also as a green striated mineral at Lucknow and Wentworth near Orange.

Talc.

Chem. comp.: Hydrous magnesium silicate. Hexagonal system.

Occurs in the form of hexagonal crystals between Gudgeby River and Naas Valley, also about Bathurst. And from Jungemonia to Uranbeen with steatite and large hornblende crystals.

Steatite.—A massive indurated form of talc or hydrous magnesium silicate.

Occurs in Ranger's Valley, Severn River, at Elsmore, and the Bolitho Tin Mine, associated with tinstone. At Jungemonia and Uranbeen, Icely.

Soapstone, Saponite.—Williams River, Icely.

Agalmatolite, or Chinese Figure Stone—In chlorite schist. Nurembla, Callalia Creek.

Meerschaum.—Chem. comp.: Magnesium silicate. Said to occur on the Richmond River. Very doubtful.

Augite Group.

Augite.

Pyroxene.—Chem. comp.: Silica, magnesia, iron, lime, &c. Oblique system. There are several varieties of olivine, which range from white or almost white to dark green, black, and opaque minerals.

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Well-formed short columnar crystals of augite are not uncommon. They are abundant at Newstead, Cameron's, and Middle Creeks; near Guntawang; Pretty's Plains, near Molong; and near to the Pigeon House. At Bruno waterfall, Callallia Creek, with mesotype and arragonite in a vesicular and amygdaloidal basalt, which rest upon columnar basalt.

Smaragdite containing native copper, occurs in a hard elvan porphyry at Molong Creek, and near to Dowagarang (the Old Man Canobolas).

Diallage.

Chem. comp.: Calcium and magnesium silicate. Occurs in small bronze-green coloured crystals in the serpentine of Bingera, Warialda, and Kelly's Creek, Gwydir River, with chrome iron. The crystals are thin, and more or less brittle; translucent.

Hypersthene.

Chem. comp.: Calcium, magnesium, and iron silicate. Found near the Lagoons, west of Gulgong.

Chrysolite Peridot.—Olivine.

Chem. comp.: Magnesium silicate. Rhombic system. Transparent bright green coloured specimens of chrysolite are common in most of the gold drifts. Found in the Shoalhaven and Hunter Rivers. Old Trigomon. Associated with the various gems in Gt. Mullen Creek, which falls into the Cudgegong; also at Two-mile Flat, Bingera, and other places. The exterior often has a white opaque enamel-like crust.

Gem Stones.

Corundum.

There are several forms of this substance—alumina. The blue is known as the sapphire, the green as the oriental emerald, the red as the ruby, the hair-brown as adamantine spar, the magenta-coloured as barklyite, and the common dark-coloured ones as corundum and emery.

Sapphire.

Chem. comp.: Alumina, or aluminum sesquioxide. Hexagonal system. The usual forms met with in New South Wales are double-sized pyramids, sometimes combined with the basal pninacoid or other pyramids; the prism is less common. Perfect crystals are, however, rare, the majority of the specimens being either fractured or waterworn. There appears to be no record of their having been found *in situ*. In certain cases it would appear from their sharp and unworn edge that they had not travelled very far. H. = 9. Sp. gr. = 3·49 to 3·59.

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The New South Wales sapphires, in common with those from other parts of Australia, are usually rather dark in colour; they, however, are found varying from perfectly colourless and transparent, through various shades of blue and green, to a dark and almost opaque blue. One or two green-coloured sapphires or oriental emeralds are almost always met with in every parcel of a hundred or so specimens, also blue and white particoloured.

Asteria or Sapphires which show a six-rayed star of reflected light are by no means uncommon.

Sapphires are almost invariably met with by the miners as an accompaniment of alluvial gold.

They are widely distributed over the New England District, as at Bingera and near Inverell, with tin, adamantine spar, zircons, topaz, and bismuthite; in Vegetable, Cope's and Nundle Creeks, the Gwydir River, Dundee, Uralla, Ben Lomond; Mann's River, the Abercrombie, Namoi, Peel, and Cudgegong Rivers; at Two-mile Flat; in Bell's River and Pink's Creek, with white topaz, almanden garnets, epidote, spinelle, chrysoberyl, chrysolite, hyacinth, etc.; at Tumberumba, with tinstone and other minerals; also in the Shoalhaven and Snowy Rivers.

The late Dr. A. M. Thomson, Professor in the Sydney University, detected a variety peculiar to the Mudgee district, which occurs in uniformly small slightly barrel-shaped hexagonal crystals of about $\frac{1}{4}$-in. long and $\frac{1}{10}$-in. diameter—opaque, and of a peculiar lavender colour.

He made out the composition as follows:—

Analysis.

Alumina	98·57
Iron Sesquioxide	2·25
Lime	·45
	101·27

H. = 9. Sp. gr. = 3·59.

Ruby, or Red Sapphire.

This is much more rare than the blue gem. The late Mr. Stutchbury reports its occurrence with sapphire, chrysolite, hyacinth, amethyst, and other gems in the Cudgegong between Eumbi and Bimbijong, and in Mullen's and Lawson's Creeks which fall into the Cudgegong. And the Rev. W. B. Clarke found it at Tumberumba with similar gems. It is found too at Mudgee, but is not common, and usually of small size; also from a small creek, about

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two miles from the head of the Hunter River. Dr. Thomson determined its composition, hardness, and specific gravity to be as follows:—

Analysis.

Alumina	97·90
Iron sesquinoxide	1·39
Magnesia	·63
Lime	·52
	100·44

H. = 9. Sp. gr. = 3·59.

Barklyite.—This name has been given in Victoria to the opaque magnesia-coloured variety.

Adamantine Spar.

Found at Two-mile Flat, Uralla, Bingara, Inverell. When cut and polished *en cabochon* this forms a very handsome ring stone.

Emerald.—Beryl.

Chem. comp.: Silica, aluminium and glucinium. Hexagonal system.

The name emerald is usually reserved for the deep green coloured stones fit for jewellery, while the less beautiful and pale varieties are termed beryls.

The emerald is said to occur mixed with granite detritus in Paradise Creek, and near Dundee. Also in gneissiform dykes on the summit of Mount Tennant, and at Lanyon to the west of that mountain; in the granite at Cooma, and in Mann's River with other gems. In some cases the beryl is probably meant.

The beryl is much more common, it is found at Elsmore associated with quartz and crystals of tinstone. The beryl crystals, which are often very thin and fragile, are seen interlaced with and seated upon tin crystals.

At Ophir the beryl occurs in white felspar with quartz and white mica; one crystal is $\frac{5}{8}$ in. through, of a pale transparent yellow green colour and vitreous lustre. Sp. gr. = 2·708.

A greenish coloured opaque beryl in small hexagonal prisms has been found in the Shoalhaven River east of Bungonia; the crystals are associated with mispickle, and in some cases they penetrate it.

Chrysoberyl.—Cymophane.

Chem. comp.: Glucinum aluminate. Rhombic system.

The late Mr. Stutchbury mentions that he found a fragment of this gem in the Macquarie River.

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Zircon, Hyacinth, Jargoon.

Chem. comp. Zirconium silicate. Pyramidal system.

The transparent red varities are known as hyacinths, the smoky jargoon; while the grey, brown, etc., are known as zircons.

This mineral is found in granite on the Mitta Mitta, and on the Moama River, some 4 miles west of Jillamalong Hill.

Zircons are very common in the auriferous river sands and drifts, as at Uralla, Bingera, Two-mile Flat, the Cudgegong, Macquarie, Abercrombie, Shoalhaven, and other rivers.

They are of course usually more or less rolled, but occasionally the crystalline form is well preserved; they vary much in colour, from more or less colourless and transparent through pale-red to crimson, brown, and opaque; they are also found of a clear transparent green, but these are rarer than the others.

Topaz.

Chem. comp.: Aluminium, silica and fluorine. Rhombic system. Occasionally met with in well-formed columnar crystals capped with planes of numerous pyramids. The best-formed crystals are usually perfectly clear, colourless, and transparent. Some very large crystals have been met with; a portion of a large bluish green-coloured crystal found at Mudgee, and now in the Melbourne Technological Museum, weighs several pounds; and others weighing several ounces are by no means rare; they are sometimes 2 to 3 inches long and broad in proportion, especially those from Uralla.

The pale bluish-green tint is the most common colour, sometimes they are slightly yellow.

It is comparatively abundant all over the granite region of New England; it occurs associated with tinstone in veins traversing the eurite and greisen granites near Elsmore and other parts; some of the small crystals found with the tin ore are beautifully developed.

Found also at Bingera, Two-mile Flat, Bathurst; Bell River, also Macquarie, Abercrombie, Shoalhaven, and Lachlan Rivers.

Spinelle.—Spinel Ruby.

Chem. comp.: Magnesium aluminate. Cubical system. Small well-formed octahedra are by no means rare; the colour varies from pale brown, red, deep crimson, green, to black (pleonaste).

It is found in most river deposits containing gold, as in the sands of the Severn and its tributaries, at Uralla, Bingera, Two-mile Flat, Bathurst, Macquarie, and Cudgegong Rivers.

Pleonaste.—Fairly well-formed large crystals of pleonaste with well-marked conchoidal fracture are found in the Lachlan River. One fairly well-formed octohedron, from the Muntabilli River, Monaro district, was remarkable for its channelled faces.

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The amorphous black vesicular pleonaste occurring on the Mudgee Diamond Fields was examined by the late Dr. A. M. Thomson; he found it to have the following composition:—

Silica and undecomposed... ...	2·75
Alumina	64·29
Sesquioxide of chromium... ...	4·62
Magnesia	21·95
Protoxide of iron...	4·49
	98·10

Sp. gr. = 3·77.

The colour is dull black, the surface vesicular; no cleavage, but a highly lustrous well-marked conchoidal fracture; streak, grey.

Anhydrous Silicates.

Kyanite.—Disthene.

Chemical composition: Aluminium silicate. Anorthic system. Occurs near to Kangaloolah, an arm of Tuena Creek some 10 miles south of Tuena. In colour it is nearly white, the lustre pearly, in slender flattened brittle crystals.

Staurolite.

Chemical composition: Aluminium silicate. Rhombic system. Occurs in a talcose schist near Bathurst, in the form of small brown prismatic crystals.

Andalusite.

Chemical composition: Aluminium silicate. Rhombic system. A vein of mineral crystallized in rhombic prisms of a pinkish-grey colour occurs in the slate rock to the east of Bungonia. The cleavage is well marked parallel to the O.P. plane; the planes of the prism have a vitreous lustre, but the terminal planes are dull. I hope to have a quantitative analysis of this very interesting mineral finished shortly.

Chiastolite (Andalusite variety of).—Chemical composition. Aluminium silicate; rhombic system. Occurs in granite rock, at Arnprior, Boro (Goulburn), and in small crystals in the slate near Modbury, Shoalhaven.

Epidote.

Chem. Comp. Silica, aluminia, lime, iron, etc.: Oblique system.

Occasionally well-developed columnar crystals have been met with, but I have seen none of large size—also massive. Usually various shades of green.

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Found in the Murrumbidgee district, near Mount Tennant; also at Bundian, with glassy felspar and quartz below; the Windindingerie Cataract; at Gedgedzerick; between Jingery, Bobbera, and Pambula; at Bibinluke, and the "Gap" Lewis Ponds; the Shoalhaven River; also to the east of Bungonia; Gulgong; Bathurst; and in the bed of the Gwydir River, and the Ora Ora.

Garnet.

Chem. Comp.: There are several kinds of garnet and they vary in composition, but the most common are silicates of alumina, lime, iron, manganese, and other bases.

Cubical system: The rhombic dodecahedron and the icositetrahedron being the most common.

It is the alumina-lime or common garnet which is most generally met with, especially in the granite ranges, as at Hartley; it is found also at Bingera, at Ponds Creek, and other places near Inverell, at Uralla, in a talc schist at Bathurst, Washpool Creek, near Solferino; Trunkey Creek, Abercrombie River, Coombing Creek Copper Mine, with hyacinth and gold on the Old Trigomon, Moama River, 4 miles west of Jillamalong Hill; at Hardwicke, near Yass.

A dark greenish-brown garnet occurs in large quantities, with magnetic iron ore, at Wallerawang, well crystallized in rhombic dodecahedra, which contains 21·05 per cent. of metallic iron.

Tourmaline.—Schorl.

Chem. comp.: Very complex, but mainly composed of silicate of alumina, iron, lime, soda, &c., with usually some 3 or 4 per cent. of boracic acid; other substances such as lithia are often present.

Crystallizes in the hexagonal system, usually in the form of prisms having a more or less triangular section, and strongly striated parallel to the principal axis. Large prisms are met with in the New England district, and also in the Murrumbidgee. When the crystals are small and more or less aggregated together into bundles, the mineral is termed schorl; the form of it is common in the granite of New England in the tin district.

Large crystals are found in the South with pegmatite between Mowwat and Burramungee; with tremolite at Jejedzeric in granite.

It is also commonly found associated with gold, diamonds, and other gems in drifts and river deposits, more or less rolled; at times all trace of the original crystallized form is removed.

Mica.

Muscovite, or Potash Mica.

Chem. comp.: Aluminium and potassium silicate. Oblique system.

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Large tabular crystals of mica are met with in the coarse-grained granite of the Bathurst District, as at Broadwater and other places on the Macquarie River, and at Cooma and Wheeo; crystals of a golden-coloured mica are also obtained from the same place, and at Orange with crystals of felspar in a pink-coloured granite.

Green mica is common in the granite of New England; the mica entering into the composition of the greisen at Elsmore, and Newstead, and other places is green. Green mica also occurs in the granite of Yarramgun and Ororal.

In the Naas Valley mica is found in large crystals, associated with quartz, felspar, hornblende, tourmaline, and chlorite.

A mammillated bright golden-coloured mica is found in white quartz at Kiandra; this has very much the appearance of rolled gold, for which in fact it has been mistaken; yellow mica also occurs in Frazer's Creek.

A bright-coloured mica with silvery lustre is met with in a manganiferous cement at Buckley's Lead, Two-mile Flat.

Large groups of beautiful plumose crystals of mica occur at Oura Station, Wagga Wagga.

Felspars.

Orthoclase.—Common Felspar.

Chemical composition: Aluminium and potassium silicate. Oblique system. There are several varieties of this mineral: *Common Felspar* includes all the common non-transparent varieties; *adularia*, the sub-transparent forms; opalescent adularia is termed *moonstone;* and *glassy felspar;* or *ice spar* comprises the clear and transparent forms.

Fine well-formed crystals of felspar are almost unknown here, although fairly large and moderately well-developed crystals are not uncommon in the coarse ground granites of the New England, Bathurst, and Southern districts. Simple and compound crystals of an inch or so in length, exposed by weathering, are common in the granite of New England. Dark grey felspar at Mount Walker. Medium sized crystals of *glassy* felspar are reported at Benada Creek, also near Naas, and with quartz at Lanyon to the west of Mount Tennant. Again near "The Pass" Bundian. With mica chlorite and quartz at Windindingerrie Cataract. Acicular crystals of glassy felspar occur in compact felspar at Mount Wingen near the burning part.

Crystallized adularia felspar is plentiful on Mount Lindesay.

Albite.

Chem. Comp.: Aluminium, sodium, and potassium silicates Doubly oblique system.

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Occurs in the form of white crystals and massive in New England, near Bingera, also in one or two places near Gulgong, where in one place it is said to be found in association with calcite opal, asbestos, epidote, sphœrosiderite, mispickle, blende, galena, pyrites, and copper pyrites in an auriferous vein traversing a diorite. It occurs crystallized with translucent quartz at Mount Dixon, Dewelamble, Murrumbidgee, and with quartz, chlorite, and green mica on the Coolalamine Plain and at the head of the Yarralumla.

Nepheline.

Chem. Comp.: Aluminium, sodium, and potassium silicate.

Hexagonal system. Occurs in amygdaloidal porphyry between the "Pinnacle," Dowagarang, and the Old Man Canobolas, near Wellington.

Spodumene.

Chem. Comp.: Aluminium and lithium silicate. Oblique. Mr. Wilkinson reports its probable occurrence at Oura Station, near Wagga Wagga.

Hauyne.

Chem. comp.: Silica, alumina, soda, lime, and sulphuric acid. Cubical system.

The Rev. W. B. Clarke discovered some small specimens of a blue-coloured mineral which he believed to be hauyne, below the Windindingerie Cataract, in association with flesh-coloured felspar, adularia, quartz, and epidote.

Hydrous Silicates.

Clays.

Kaolin, or China Clay.

Is derived from the decomposition of felspar, and is not uncommon in many parts of the Colony. A deposit of kaolin suitable for the manufacture of the best porcelain is reported to occur at Lambing Flat, King's Plains, and another of a dazzling white colour on a hill near to Rocky Ridge, which is in association with a bright and pretty coloured lavender clay derived from decomposed basalt.

Fire Clays.

Of good quality are common throughout the coal measures; and in the shales, claystone nodules which would probably yield high-class cement are plentiful.

Brick Clays.—Large deposits of clay, which burn to red, white, and intermediate colours, are common in the County of Cumberland, derived from the disintegration of the Wianamatta shale.

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Halloysite.

Chem. comp.: Hydrous silicate of alumina.

This is an amorphous earthy mineral, resembling steatite, derived from the decomposition of igneous rocks. Adheres to the tongue, can be scratched and polished by the nail; of various colours—black, brown, grey, green, and red; the black often contains small brilliant white veins. When placed in water the mineral usually falls to pieces, and the edges become translucent.

Specimens of black halloysite are from time to time brought from all parts of the Colony as samples of graphite.

Occurs in railway cutting through decomposed basalt containing chabasite at Reedy and Stony Creeks, Sutton Forest; at Two-mile Flat of a pretty green colour; Carcoar and Lachlan River.

Zeolites.

This group of minerals is distinguished by the property which most of them possess of fusing with intumescence before the blow-pipe, *i.e.*, they boil up, the name being derived from ζηω, to boil, and λιθος, a stone. The are usually found filling the amygdaloidal cavities and crevices in igneous rocks, and never as crystals disseminated through the mass of the rock like pyrites, garnet, or mica. In chemical composition they consist essentially of compound silicates of alumina, the alkaline earths and alkalis; and when treated with acids gelatinous silica is separated.

Stilbite.

Chem. comp.: Hydrous silicate of alumina and lime. Rhombic system. Reported to occur in metamorphic silurian shales at Adelong.

Laumonite.

Chem. comp.: Hydrous silicate of alumina and lime. Oblique system. This mineral occurs in the form of white crumbly prismatic crystals in association with black and white particoloured calcite crystals in the cavities of an amygdaloidal rock on the road between Geringong and Kiama.

There is a pink mineral in slate on the Mudgee Road, found by Mr. Wilkinson, which is probably a laumonite. (For further particulars see Report upon New South Wales, part I., p 20.) On analysis this mineral yielded the following results:—

Silica	53·266
Alumina, and trace of iron oxide ...	22·833
Lime...	11·000
Water of combination	12·646
Specific gravity, between 2-3	100,224

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It also occurs as a white powdery mineral in a soft grey-coloured amygdaloidal trachytic rock at Myalla. This mineral may at once be recognized from its readiness to undergo decomposition.

Mesotype.

Chem. comp.: Hydrous silicate of alumina and soda. Found in amygdaloidal basalt. Locality (?)

Scolezite.

Same chem. comp. as the above. Rhombic system. This mineral is found with cylindrical masses of bitter spar in a basalt, Emu Creek, New England. It is distinguished by curling up like a worm before the blowpipe,—hence the name, from σκωληξ, a worm.

Analcime, or Cubical Zeolite.

Chem. comp.: Hydrous silicate of alumina and soda. Cubical system. Occurs at Inverell.

Chabasite.

Chem. comp.: Hydrous silicate of alumina, lime, and potash; Hexagonal system: commonly assumes rhombohedral forms. This is perhaps the most abundant of the New South Wales zeolites, and the crystals are often very well developed. It occurs in basalt with delessite at Musclebrook. And in well-formed rhombohedra in trachyte on the Lachlan River; also in an amygdaloidal basalt at Reedy Creek, Sutton Forest; with calcite in a similar rock at Coroo. It also occurs in the cavities of a puce-coloured rock at Fountain Head in simple rhombohedral crystals of a wax-yellow colour, and is associated with a bright orange-coloured powdery mineral and a grey-green steatitic substance; the matrix can be readily cut with a knife, and leaves a shiny streak.

It is also reported from the Talbragar and Abercrombie Rivers, and is present in the basalt of the Illawarra district.

Herschelite.

This is probably only a variety of gmelinite, one of the chabasite group, and occurs with calcite and analcime, crystallized in double hexagonal pyramids at Inverell.

Prehnite.

Chemical Composition: Hydrous silicate of alumina and lime. Rhombic system. Occurs at Emu Creek, New England, of a green colour; and in association with orthoclase felspar and copper ores, at Reedy Creek, Molong.

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List of Minerals mentioned in the foregoing Paper :—

	PAGE.
Actinolite	46
Adamantine Spar	50
Adularia	54
Agalmatolite	47
Agate	43
Albite	54
Alum	41
Amethyst	43
Amianthus	46
Amphibole	46
Analcime	57
Anatase	28
Andalusite	52
Anglesite	24
Anhydrous Silicates	52
Anthracite	35
Antimonite	29
Antimony, Native	29
Antimony Oxide	30
Antimonial Copper Ore	17
Antimony Sulphide	29
Apatite	40
Argentite, Silver Sulphide	12
Arragonite	38
Arsenic, Native	29
Arsenical Pyrites	29
Asbestus	46
Asteria	49
Agalmatolite	47
Atacamite	15
Augite	47
Azurite	15
Barklyite	50
Barytes	38
Bellmetal Ore	17
Beryl	50
Bismuth, Native	30
Bismuthite	30
Bitumen, Elastic	36
Blende	23
Bog-butter	36
Bog Iron Ore, Limonite	20
Bornite	17
Brick Clay	55
Brookite	28
Brown Coal, Lignite	35
Cacholong	45
Cairngorum	42
Calcite	39
Carnelian	44
Cassiterite	25
Cerussite	24
Cervantite	30
Chabasite	57

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	PAGE.
Chalcedony	44
Chalcopyrites	17
Chalcotrichite	14
Chalybite	20
Chert	44
Chiastolite	52
Chlorite	46
Chromite, Chrome Iron	21
Chrysoberyl	50
Chrysocolla	15
Chrysolite	48
Cinnabar	13
Clays	55
Coal, Common	33
„ Brown, Lignite	35
„ Cannel	33
„ Anthracite	35
Cobalt, Oxide	23
Condurrite	16
Copper, Native	13
„ Black Oxide, Tenorite	14
„ Red Oxide, Cuprite	14
„ Chloride, Atacamite	15
„ Blue Carbonate, Chessylite	15
„ Green Carbonate, Malachite	14
„ Grey Sulphide, Copper Glance	16
„ Pyrites	17
„ Purple, Bornite	16
Copper-nickel	22
Corundum	48
Cuprite	14
Cyanite, Kyanite	52
Cymophane	50
Delessite	46
Diallage	48
Diamond	31
Disthene	52
Domeykite	17
Earthy Minerals	38
Eisenkiesel	44
Elaterite	36
Emerald	50
Emery	48
Epidote	52
Epsomite	41
Fahlerz	16
Felspar, Common	54
„ Glassy	54
Figure-stone	47
Fire-clay	55
Flos-ferri	38
Fluor-spar	40
Galena	25
Garnet	53
Gems	48
Girasol	45

Digitized by Google

	PAGE.
Gmelinite	57
Gold	2
„ Nuggets	2
„ Silver, &c., in	5
„ Vein	9
„ Associations	9
„ Distribution	10
„ Amount of	10
„ Discovery	10
Göethеite	19
Graphite	33
Green Earth	46
Gypsum	38
Hæmatite	18
Halloysite	56
Hauyne	55
Heavy-spar	38
Herschelite	57
Hornblende	46
Hyacinth	51
Hyalite	45
Hydrous Silicates	55
Hypersthene	48
Ice-spar	54
Iceland-spar	39
Ilmenite	21
Iridium	13
Iron, Native	17
„ Brown Hematite	19
„ Carbonate	20
„ Chromate	21
„ Limonite	20
„ Pharmacosiderite	21
„ Phosphate	...
„ Magnetic pyrites, Pyrrhotine	22
„ Pyrites	22
„ Scorodite	21
„ Spathic	20
„ Specular	18
„ Sulphide	22
„ Titaniferous	21
Iron-ores	17
„ Brown	19
„ Magnetic	18
Iserine	21
Jamesonite	30
Jargoon	51
Jasper	44
„ Ribbon	44
Jet	37
Kampylite	24
Kaolin	55
Kerosene Shale	36
Kupfernickel	22
Kupfermanganerz	23
Kyanite	52

Digitized by Google

	PAGE.
Laumonite	56
Lead, Native	24
„ Arseniate	24
„ Carbonate	24
„ Molybdate	24
„ Oxide, Red Lead	24
„ Phosphate	24
„ Sulphate	24
„ Sulphide, Glance	25
Lignite	35
Lime, Carbonate	38
„ Phosphate	40
„ Sulphate	38
Lydianstone	44
Magnesia, Carbonate	41
„ Sulphate	41
Magnesite	18
Magnetite	41
Magnetic Pyrites	22
Malachite	14
Manganese	23
Marble	39
Marcassite	22
Marmolite	47
Meerschaum	47
Melaconite, Tenorite	14
Menaccanite	21
Mercury, Native	13
„ Sulphide, Cinnabar	13
Mesotype	57
Mica	53
Mineral Wax	36
Mimetite	24
Minium	24
Mispickle	29
Molybdenite	28
Moonstone	54
Muller's Glass, Hyalite	45
Muscovite	53
Natron	38
Nepheline	55
Nickel, Arsenides	22
Nigrine	21
Olivenite	16
Olivine	48
Oolitic Limestone	40
Opal	45
Orthoclase	54
Osmo-iridium	13
Ozokerite	36
Pectolite	46
Peridot	48
Pharmakosiderite	21
Phosphocalcite	16
Picrolite	47
Plakodine	22

Digitized by Google

	PAGE.
Platinum	13
Pleonaste	51
Plumbago	33
Porcelain Clay, Kaolin	55
Prehnite	57
Pyrites, Iron	22
„ Marcassite	22
„ Magnetic	22
Pyromorphite	24
Pyroxene	47
Pyrrhotine	22
Quartz	42
Quicksilver, *vide* Mercury	13
Redruthite	16
Resinite	36
Rock-crystal	42
Ruby, Oriental	49
„ Spinelle	51
Rutile	27
Sahlite	46
Salt, Common	38
Saponite	47
Sapphire	48
Scheelite	28
Schorl	53
Scolezite, Skolézite	57
Scorodite	21
Selenite	38
Serpentine	47
Shale, Kerosene	36
Siderite	20
Silica	42
Silicified Wood	45
Silver, Native	12
„ Antimonial	13
„ Sulphide	12
Smaragdite	48
Soapstone	47
Soda, Carbonate	38
Sodium Chloride	38
Specular Iron Ore	18
Sphærosiderite	20
Sphene	28
Spinelle	51
Spodumene	55
Staurolite	52
Steatite	47
Stilbite	56
Strontianite	40
Sulphur	38
Talc	47
Tellurium, Native	29
Tenorite	14
Tetrahedrite	16
Tin-ore	25
Titanium	27
Topaz	51

Digitized by Google

	PAGE.
Torbanite	36
Tourmaline	53
Travertine, Fresh-water Limestone	39
Tremolite	46
Tungsten	28
Wad	23
Wavellite	40
Websterite	42
Williamsite	47
Wolfram	28
Wood Opal	45
Wulfenite	24
Zeolites	56
Zinc-blende	23
Zircon	50

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